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Adapted Motivational Interviewing to improve uptake of glaucoma treatment in Bauchi, Nigeria

MOHAMMED MAHDI ABDULL

Thesis submitted in accordance with the requirements for the degree of Doctor of Philosophy

**University of London
July 2017**

**Department of Clinical Research
Faculty of Infectious and Tropical Diseases
London School of Hygiene & Tropical Medicine**

Funded by
British Council for Prevention of Blindness
Seeing is Believing Innovation fund

Research group affiliation(s): International Centre for Eye Health (ICEH)

DECLARATION

I, Mohammed Mahdi Abdull confirm that the work presented in this thesis is my own. Where information has been derived from other sources, I confirm that this has been appropriately indicated in the thesis.

Signature:

A handwritten signature in black ink, appearing to read 'ABDULL', is placed on a light blue rectangular background.

Date: 03 January 2017

GLOSSARY

5-FU	5-Fluorouracil
ACG	Angle closure glaucoma
ACTG	AIDS Clinical Trials Group
AIDES	Assessment, Individualization, Documentation, Education and Supervision
AIDS	Acquired immunodeficiency syndrome
AMD	Age-related macular degeneration
ART	Anti retroviral therapy
ATBUTH	Abubakar Tafawa Balewa University Teaching Hospital
BMI	Body mass index
BP	Blood pressure
CAPS	Centre for AIDS Prevention Studies
CDC	Centre for Disease Control
CDR	Cup-disc-ratio
CI	Confidence interval
CONSORT	Consolidated Standards of Reporting Trials
DALY	Disability-Adjusted Life Year
dB	Decibels
DBP	Diastolic blood pressure
DR	Diabetic retinopathy
FDR	First degree relative
FDT	Frequency doubling technology
FGD	Focus group discussion
FM	Frequency modulation
GP	General practitioner
GWAS	Genome-wide association study
HBM	Health belief model
HE	Health Education
HFA	Humphrey visual field
HIV	Human immunodeficiency virus
ID	Identity
IDDM	Insulin dependent diabetes mellitus
IDI	In-depth interview
IOP	Intraocular pressure
ISGEO	International Society Geographical & Epidemiological Ophthalmology
LMIC	Low middle income countries
MA	Mohammed Abdull
MC	Mitomycin-C
MI	Motivational interviewing
MIG	Motivational interviewing for glaucoma
MITI	Motivational interview treatment integrity scale
MOPP	Mean ocular perfusion pressure
NCCSDO	National Coordinating Centre for the National Health Service (NHS) Service Delivery and Organization

NCD	Non communicable diseases
NHS	National health service
NPDR	Non proliferative diabetic retinopathy
OAG	Open angle glaucoma
OPD	Out patient department
OR	Odds ratio
PBS	Population based survey
PDR	Proliferative diabetic retinopathy
PEP	Post exposure prophylaxis
POAG	Primary open angle glaucoma
PSED	Posterior segment eye disease
PVA	Presenting visual acuity
PXE	Pseudoexfoliation syndrome
RAAB	Rapid assessment of avoidable blindness
RAPD	Relative afferent pupillary defect
RR	Risk ratio
SBP	Systolic blood pressure
SD	Standard deviation
SSA	Sub Saharan Africa
SVI	Severe visual impairment
TDA	Travatan dosing aid
TDLC	Transscleral diode laser cyclophotocoagulation
TTM	Trans theoretical model
UP	Universal precaution
VA	Visual acuity
VCDR	Vertical cup-disc-ratio
VFD	Visual field defect
WAI	Working alliance inventory
WAI-SR	Working alliance inventory Short Questionnaire
WHO	World health Organization

ABSTRACT

Background

Glaucoma is a major cause of irreversible blindness in Africa due to its high prevalence, early age of onset and aggressive course. Patients often present very late and have poor awareness and limited access to services with limited treatment options to lower the intraocular pressure. When treatment is available there is often poor acceptance of surgery, the preferred treatment in Africa. To prevent blindness from glaucoma a behaviour change intervention is required to increase awareness and encourage acceptance of and adherence to treatment and follow up. Motivational interviewing (MI) was selected and adapted for this study as it has shown promise in adherence to treatment in other chronic diseases, and non professional counsellors can be trained to deliver it. To improve treatment options transscleral diode laser cyclophotoablation was introduced before the trial started

Methods

Design: single site pragmatic randomized controlled trial with 1:1 allocation to one session of MI or enhanced usual care. MI was adapted for the local context and language was carried out using an interview guide generated following qualitative research. Participants allocated to MI were randomly allocated to one of two interviewers. Usual care was routine explanation by an ophthalmologist and an educational pamphlet. After the interview, a 12-item Working Alliance Inventory short questionnaire was administered to patients and interviewers to assess the collaborative relationship. The primary outcome of the trial was the proportion of participants who accepted and underwent surgery or laser treatment within two months of the date given. Laser treatment was performed using diode 810nm laser G-probes under retrobulbar anaesthesia and standard procedures. Patients were reviewed on day one, one week and at 1, 4, 6 and 12 months when IOP and visual acuity were measured.

Results

276 patients participated in the trial: 135 (49%) were assigned to MI and 141 to usual care. 53% of patients in the MI group underwent treatment compared with 45% in the usual care group (risk ratio 1.2; 95% confidence interval (CI) 0.9-1.6). Overall acceptance was

49% higher than before the trial. Analysis of WAI scores showed similar scores for participants and interviewers overall. Interviewer and participant scores had high reliability coefficients (94.3% and 93.3% respectively) with good correlation when combined using Cronbach's alpha (93.9%). In the laser treatment study, data from 204 eyes treated were included in the study. Before treatment mean IOP was 39mmHg being 12, 11, 15, 18, 19 and 19mmHg on day one, at one week, and 1, 4, 6 and 12 months respectively. At 12 months 77 (72.6%) eyes (106/107 with data) had IOPs <22mmHg. At 12 months 83 (78%) eyes retained (70 eyes, 66%) or had improved (13 eyes, 12%) visual acuity; 25 eyes (23%) lost acuity. 17 eyes were retreated. No eyes had persistent hypotony.

Conclusion

The results do not support the introduction of this adapted MI tool to increase acceptance of glaucoma surgery in Africa as we observed only a small increase in acceptance compared with usual care, which was not statistically significant. Although only 1 in 2 patients accepted surgery or laser in this trial this is a much higher proportion than observed in other studies. In this trial the majority of participants underwent laser treatment, which is less invasive, repeatable and cheaper than trabeculectomy. The diode laser treatment appears to be a good alternative to surgery in this setting as it is acceptable, gives good IOP control and good preservation of vision at one year. Trials of different modalities of laser as a primary treatment for glaucoma in Africa are warranted.

PREFACE (format of the thesis)

The thesis for this PhD uses the “research/review paper” format that was recently introduced by the London School of Hygiene & Tropical Medicine. It therefore includes a number of papers, which have been published or are formatted for submission to peer-reviewed journals. The chapters listed in the Contents page are formatted this way and include publication details in a cover sheet, which includes acknowledgement of the contributions of other people I worked with. Information and data that make the body of the thesis more coherent and not presented or covered in the papers is included as “linking material” in other chapters. I, Mohammed M Abdull, wrote the linking material.

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DEDICATION

This work is dedicated to the memory of my father, Alhaji Abdu Ibrahim and mother Hauwa Abdulhamid, who both sadly died during the course of this study, which they passionately encouraged and supported the only way only loving parents would.

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INTRODUCTION

How ideas for the thesis developed

As an ophthalmologist working in Africa, I was frustrated that when it came to managing glaucoma patients we seemed to be making no progress at all. I noticed that many of my patients were not aware of the seriousness of their condition, and did not understand the rationale for continued adherence to medication. I was concerned to hear from my patients that they had not been using their medication regularly, so that it was not possible at follow up to know whether uncontrolled IOP was due to medical treatment failure or simply poor adherence. To avoid this vicious cycle of poor adherence we often advise early surgery which patients usually refuse, as they do not understand why surgery is needed for a seeing eye and not for a blind eye (as with cataract).

My interest in glaucoma was further increased after seeing the results from the Nigeria blindness and low vision survey. Concern for my patients informed my decision to try and find a solution to increase acceptance of early surgery and to improve adherence to medication and follow up to prevent needless blindness in patients often are often in their prime. My reading of the literature suggested that this goal could be achieved by an increasing treatment options and by improving patient's awareness. This concern formed the basis of this study.

The following chapter describes the epidemiology of glaucoma in Africa. The table in the chapter summarises the prevalence and the proportion of blindness caused by glaucoma in various African population. Data were sourced from a comprehensive review of large population and hospital based surveys.

The structure of the rest of the thesis

Chapter 1. Describes glaucoma epidemiology and risk factors in Africa. These papers were written with colleagues also working on glaucoma and jointly carried out reviews of published data on glaucoma in Africa. There are 3 published papers included in the chapter. The first is a review of the epidemiology of glaucoma in sub-Saharan Africa. The second is an analysis of risk factors for glaucoma in Africa from the results of the National Blindness and Low Vision Survey (NBS). The NBS was the largest prevalence study of blindness and low vision carried out in Africa and field work was undertaken between 2004- 2007. I was part of the team that carried out the survey and collected the data. As the survey was designed to cover more than 500 million people who share the same ecological zones in west, central and eastern Africa, the findings may apply to a much larger population. The third paper is another review of posterior segment eye diseases in Africa.

Chapter 2. This describes the challenges that glaucoma poses in Africa. It starts with a review of the unique challenges faced by both patients and ophthalmologists in managing glaucoma. It reviews the outcome of surgical treatment for glaucoma in African patients and also discusses health education and different approaches to increasing awareness and knowledge of glaucoma to overcome some of the challenges. Motivational interviewing (MI) is introduced and the rationale for using it in this study to address the problem of poor acceptance of surgery. There are two published papers in this chapter. The first illustrates the late presentation of glaucoma and very poor acceptance of treatment among patients presenting to the eye department where I work in northern Nigeria. The second introduces glaucoma as the “silent thief of sight” and describes glaucoma from the patients’ perspectives and explores their health seeking behaviour

Chapter 3 describes MI in more detail and its use in managing adherence to treatment in other conditions. The paper in this chapter is a narrative submitted for publication of our effort in learning MI and the challenges we faced in a non-western society.

Chapter 4 is a general description of the context of the study and describes the study location. Papers included in this chapter give a background of the usual care for glaucoma in the study location and describe a case study of a typical glaucoma patient in Nigeria with suggestions on how to manage such patients. The last two papers describe

the general medical care of glaucoma patients and how to manage the patient after glaucoma surgery in the setting.

Chapter 5 describes the clinical trial along with the rationale, aims and objectives and a detailed methodology. The study protocol of the trial forms the first published paper in the chapter while the second is an educational poster produced for patient education.

Chapter 6 describes the primary outcome of the clinical trial in a published paper.

Chapter 7 introduces a new intervention, transcleral diode laser cyclophotocoagulation (TDLC), in an attempt to increase the options available for patients to treat glaucoma in Africa. It describes TDLC, the rationale for using it and a brief review of diode lasers in Africa. The paper describes the results from a cohort of patients treated with cyclodiode and followed up for one year.

Chapter 8 describes the implications of the findings of my work for practice, policy and further research. It discusses what next as the primary outcome of the trial failed to prove the hypothesis.

Chapter 1. Glaucoma in Africa: Epidemiology,

Description of glaucoma and definitions

The following chapter describes the epidemiology of glaucoma in Africa. The table in the chapter summarises the prevalence and the proportion of blindness caused by glaucoma in various African population. Data were sourced from a comprehensive review of large population and hospital based surveys.



Figure 1: A typical blind glaucoma patient being led to the eye clinic by his son in Bauchi, Nigeria,

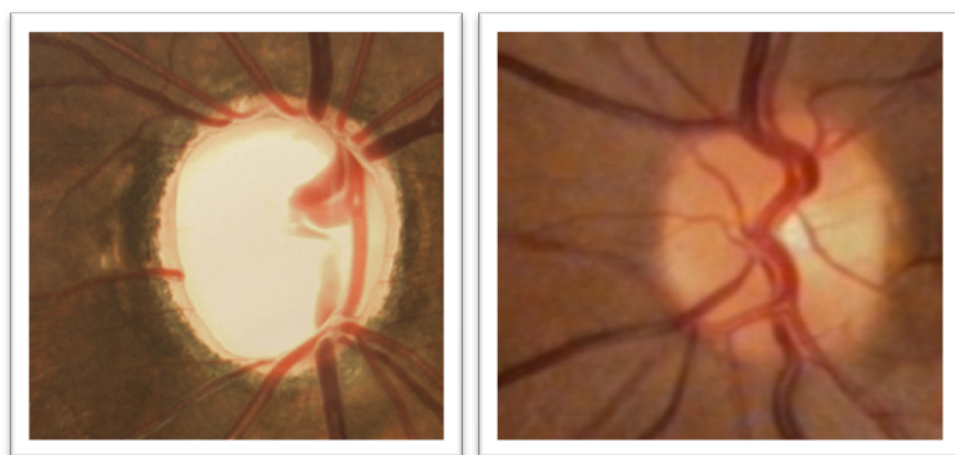


Figure 2: Optic disc photos. On the left, glaucomatous optic atrophy, and normal optic disc on the right

Glaucoma

Glaucoma is a group of acquired conditions characterised by optic neuropathy and typical patterns of visual field loss in more advanced stages.[1] In the public health context, glaucoma is an optic neuropathy associated with characteristic structural damage to the optic nerve and associated visual dysfunction that may be caused by various pathological processes.[2] The glaucomas can be classified based on the underlying abnormality that causes raised intraocular pressure (IOP) into primary open angle glaucomas (POAG), angle closure glaucomas, and glaucomas associated with developmental anomalies.[3] Glaucoma can be primary or secondary to other ocular conditions such as ocular trauma, neovascularisation, uveitis, drugs (e.g. steroids), diabetes mellitus and complicated or intumescent cataract.

Epidemiology of glaucoma

Glaucoma causes irreversible blindness in 4.6 to 6.7 million people worldwide. [4, 5] [4, 5] The number of people with glaucoma was estimated to be 60.5 million in 2010, which will increase to almost 80 million by 2020. [6]

Data from the national blindness and low vision survey in Nigeria revealed the prevalence of blindness in all ages to be 0.78%. 16.3% of this blindness was due to glaucoma, which was the 2nd commonest cause after cataract.[7] The prevalence and proportion of blindness caused by glaucoma from various studies in Africa or people of African origin is summarised in **table 1**

Risk factors for glaucoma

High Intraocular pressure

Risk factors for glaucoma include raised IOP, increased age, African Caribbean origin, and family history of glaucoma.[8] The risk of glaucomatous optic nerve damage increases with the height of the screening IOP. Results in the Baltimore eye survey confirmed that IOP is an important factor in glaucoma.[9]

Family history

Primary open angle glaucoma (POAG) has been shown to be familial. The relative risk of developing glaucoma in the Rotterdam study was 9.2 for individuals with a family history

of glaucoma.[10] In a Tasmanian study, adjusted analysis revealed that a family history of glaucoma in first-degree relatives (FDRs) and IOP of >21 mm Hg were significantly associated with glaucoma and showed that for a person with POAG the odds ratio of having a positive family history was 4.1 (95% confidence interval: 3.2–5.2). [11]

Other Risk Factors

There are other risk factors that have been observed. The Los Angeles Latino study revealed that older age, male gender, unmarried marital status, and being a first-degree relative were independent risk factors for OAG.[12] Others at risk are myopes,[13] diabetics and black people aged 40 years and above,[14] etc. Risk factors from the Nigeria national blindness survey include high IOP, increasing age and Igbo ethnicity as independent risk factors. Others were low BMI, severe hypertension, long axial length and illiteracy.[15] Individuals of African descent have thinner corneas[16] and IOP may be underestimated in blacks because of thinner corneas.[17] They also have greater optic disc area and cup depth than Europeans.[18]

Table 1. Prevalence or proportion of blindness caused by glaucoma in different African populations

	Study/ref	Year	Place of study	Study type	Age range(y ears)	POAG prevalence (%)	blindness by POAG (%)	Number examined	Remarks
1.	Buhrmann. [19]	2000	Kongwa, Tanzania	Pop based	≥40	3.08		3247	
2.	Rotchford. [20]	2002	Kwazulu Natal, S/Africa	Pop based	≥40	2.7	22	1005	
3.	Rotchford. [21]	2003	Temba, S/Africa	Pop based	≥40	2.9		839	87% not previously diagnosed
4.	Tielsch JM et al. [22]	1991	Bailtimore USA	Pop based	≥40	blacks 4.74 whites 1.29		2395 2913	Glaucoma 4-5 times higher in blacks
5.	Quigley HA et al. [23]	2001	Arizona, US	Pop based	≥40		1.97	4774	37% of POAG cases not aware they had it before the study. Gender, BP, smoking not risk factors
6.	Sommer A et al. [24]	1991	Bailtimore, USA	Pop based	≥40		Blacks 19	2395	
7.	Abdull MM et al. [7]	2009	Nigeria	Pop based	≥40	0.7%	16.7	13,599	
8.	Melese, M.et al. [25]	2003	Central Ethiopia	Pop based	≥40		Blindness 7.0% Glaucoma7.6%	2693	
9.	Ntim-Amponsah et al. [26]	2004	Akwapim, Ghana	Pop based	≥30	≥30=7.7 ≥40=8.5		1785	
10	Kalua K et al. [27]	2011	South Malawi	Pop based	≥50		15.8	3430	
11.	Ezepue UF. [28]	1997	Anambra, Nigeria	Pop based	≥50		17.65	1752	
12.	Adeoye A et al. [29]	1996	Osun, Nigeria	Pop based	0 - >60		11.1	2921	
13.	Negrel AD et	1995	Benin Republic	Pop based	All ages		15	7047	

	al. [30]								
14	Wilson MR et al. [31]	1996	North Cameroon	Pop based	≥6		12	10647	
15	Negrel AD et al. [32]	1990	Conge	Pop based	0 - >50		9	7041	
16	Zerihun N et al.[33]	1997	Jimme, Ethiopia	Pop based	0 - >70		9.5	7423	
17	Chirambo MC et al.[34]	1986	Malawi	Pop based	0 - >70	0.19	15	1664	
18	Cook CD et al. [35]	1993	Kwazulu Natal, S/Africa	Pop based	0 - ≥90		22.9	6090	
19	Bucher PJ et al.[35]	1988	N. Transvaal, S/Africa	Pop based	0 - ≥75		6	71200	
20	Preussner PR et al.[36]	2009	Western Cameroun	Pop based	5 - 90	8.2		635	
21	Adeoti CO.[37]	2004	Osun, Nigeria	Pop based	0 - 80		15.8	3204	
22	Abdu L.[38]	2002	Kano, Nigeria	Pop based	1 - 70		15	3596	
23	Balo PK et al. [39]	2000	Southern Togo	Pop based	≥5 mean 28.2	1.9		1738	
24	Balo K et al.[40]	1989	4 regions of Togo	Pop based			6%	11,081	Blindness prev 0.82% overall
25	Abiose A et al.[41]	1994	Kaduna, Nigeria	Pop based, Oncho area	≥5		8.8	6831	
26	Ekwerekwu CM et al.[42]	2002	Enugu, Nigeria	Pop. Based, Oncho area	≥30	2.1		664	42% diagnosed earlier
27	Schwartz EC et al.[43]	1997	Central African Republic	Pop based, Oncho area	0 - >50		2.2	6086	
28	Adegbehingbe et al.[44]	2006	Osun, Nigeria	Pop based	≥60	-	Blindness 5.6% glaucoma 32.4%	681	Blindness twice in men than women
29	Murdoch IE et al.[45]	2001	Northern Nigeria	Pop based	≥5	≥45=1.02		1563	
30	Ellong A et al.[46]	2006	Douala Cameroon	Retrospective, Hospital based	mean 53.3	4.3		24462	76.6% not previously diagnosed
31	Oluleye TS	2006	Ibadan, Nigeria	Prospective,	4 - 96		29	1544	

	et al.[47]			hospital based	mean 53.5				
32	Richard AI.[48]	2010	Bayelsa, Nigeria	Hospital based	3 - 90		22	230	
33	Dawodu OA et al.[49]	2003	Edo, Nigeria	Retrospective, Hospital based	0 - >60		19.2	9049	
34	Eballe AO et al.[50]	2008	Younde, Cameroon	Retrospective, Hospital based	Mean age= 62.2	2.27		8123	34.2% were bil blind
35	Gyasi M et al.[51]	2010	Upper East Region, Ghana	Hospital based	median 56		34.1	446	70% CDR>0.8, 54.9% CDR=1, M2x F
36	Agbeja-Baiyeroju AM et al.[52]	2003	Ibadan, Nigeria	Hospital workers		2.7		2109	
37	Kaimbo WK et al.[53]	1997	Kinshasa, Congo	Factory based	26 - 60	8.5		260	
38	Wormald RP et al.[54]	1994	Afrocaribbeans/ London, UK	Voluntary sample	≥35	3.9		873	RR 3.7 compared to white Irish

The following papers review the epidemiology of glaucoma in sub-saharan Africa and discuss evidence regarding risk factors for the onset and progression of glaucoma and risk factors for glaucoma blindness. Three papers follow. These are:

1. Epidemiology of glaucoma in sub-saharan Africa: prevalence, incidence and risk factors. Kyari F, Abdull MM, Bastawrous A, Gilbert CE, Faal H. Middle East Afr J Ophthalmol. 2013;20(2):111-25.
2. Risk factors for open-angle glaucoma in Nigeria: results from the Nigeria National Blindness and Visual Impairment Survey Kyari F, Abdull MM, Wormald R, Evans JR, Nolan W, Murthy GV, et al.. BMC Ophthalmol. 2016;16:78.
3. Posterior segment eye disease in sub-Saharan Africa: review of recent population-based studies. Bastawrous A, Burgess PI, Mahdi AM, Kyari F, Burton MJ, Kuper H.. Trop Med Int Health. 2014.

Paper 1: Epidemiology of glaucoma in sub Saharan Africa: Prevalence incidence and risk factors

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RESEARCH PAPER COVER SHEET

PLEASE NOTE THAT A COVER SHEET MUST BE COMPLETED FOR EACH RESEARCH PAPER INCLUDED IN A THESIS.

SECTION A – Student Details

Student	Mohammed M Abdull
Principal Supervisor	Clare Gilbert
Thesis Title	Adapted motivational interviewing to improve uptake of treatment in glaucoma patients in Bauchi state, Nigeria

If the Research Paper has previously been published please complete Section B, if not please move to Section C

SECTION B – Paper already published

Where was the work published?	Middle East Afr J Ophthalmol		
When was the work published?	April/June 2013		
If the work was published prior to registration for your research degree, give a brief rationale for its inclusion	N/A		
Have you retained the copyright for the work? ^a	Yes, see appendix 5a	Was the work subject to academic peer review?	Yes

^aIf yes, please attach evidence of retention. If no, or if the work is being included in its published format, please attach evidence of permission from the copyright holder (publisher or other author) to include this work.

SECTION C – Prepared for publication, but not yet published

Where is the work intended to be published?	
Please list the paper's authors in the intended authorship order:	
Stage of publication	

SECTION D – Multi-authored work

For multi-authored work, give full details of your role in the research included in the paper and in the preparation of the paper. (Attach a further sheet if necessary)	Participated in the literature review, researched and formed the prevalence tables, participated in other analysis and write up of the paper
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Student Signature: Asell

Date: 15 December 2016

Supervisor Signature: Clare Gilbert

Date: 15 December 2016

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Epidemiology of Glaucoma in Sub-Saharan Africa: Prevalence, Incidence and Risk Factors

Fatima Kyari^{1,2}, Mohammed M. Abdull^{1,3}, Andrew Bastawrous¹, Clare E. Gilbert¹, Hannah Faal^{4,5}

ABSTRACT

Purpose: The purpose of this study is to review the epidemiology of different types of glaucoma relevant to Sub-Saharan Africa (SSA) and to discuss the evidence regarding the risk factors for onset and progression of glaucoma, including risk factors for glaucoma blindness.

Methods: Electronic databases (PubMed, MedLine, African Journals Online- AJOL) were searched using the full text, Medical Subject Headings (MeSH) terms, author(s) and title to identify publications since 1982 in the following areas: population-based glaucoma prevalence and incidence studies in SSA and in African-derived black populations outside Africa; population-based prevalence and incidence of blindness and visual impairment studies in SSA including rapid assessment methods, which elucidate the glaucoma-specific blindness prevalence; studies of risk factors for glaucoma; and publications that discussed public health approaches for the control of glaucoma in Africa.

Results: Studies highlighted that glaucoma in SSA is a public health problem and predominantly open-angle glaucoma. It is the second-leading cause of blindness, has a high prevalence, an early onset and progresses more rapidly than in Caucasians. These factors are further compounded by poor awareness and low knowledge about glaucoma even by persons affected by the condition.

Conclusion: Glaucoma care needs to be given high priority in Vision 2020 programs in Africa. Many questions remain unanswered and there is a need for further research in glaucoma in SSA in all aspects especially epidemiology and clinical care and outcomes involving randomized controlled trials. Genetic and genome-wide association studies may aid identification of high-risk groups. Social sciences and qualitative studies, health economics and health systems research will also enhance public health approaches for the prevention of blindness due to glaucoma.

Key words: Africa, Epidemiology, Glaucoma prevalence, Glaucoma risk factors, Open-angle glaucoma, Sub-Saharan Africa

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INTRODUCTION

Data from population-based surveys (PBS) indicate that glaucoma is the second leading cause of blindness, accounting for 8% of blindness among the 39 million people who are blind world-wide.¹ In Africa, glaucoma accounts for 15% of blindness and it is the region with the highest prevalence of blindness relative to other

regions world-wide² (Adapted from Resnikoff, 2004)² [Table 1]. In 2006, the number of individuals estimated to be bilaterally blind from glaucoma was projected to increase from 8.4 million in 2010 to 11.1 million by 2020.³ However, the numbers who are blind is just the tip of the iceberg as there are many more individuals with glaucoma who are at risk of blindness. In 2006, modeling the available data, it was estimated that 60.5 million

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Table 1: Blindness prevalence and glaucoma-specific blindness prevalence by WHO sub-regions

WHO sub-region	Blindness prevalence estimate. All ages (%)	Proportion of blindness due to glaucoma (%)	Glaucoma-specific blindness prevalence	
			All ages (per 1000)	Age 40+ years (%)
Afr-D	1.00	15	1.50	0.8
Afr-E	1.00	15	1.50	0.8
Sear-B	1.00	14	1.40	0.8
Emr-D	0.97	11	1.07	0.6
Emr-B	0.80	10	0.80	0.4
Eur-C	0.40	20	0.80	0.4
Wpr-B1	0.60	11	0.66	0.4
Eur-B1	0.40	15	0.60	0.3
Sear-D	0.60	9	0.54	0.3
Wpr-A	0.30	18	0.54	0.3
Eur-B2	0.30	16	0.48	0.3
Wpr-B2	0.80	6	0.48	0.3
Amr-B	0.30	15	0.45	0.3
Amr-D	0.50	8	0.40	0.2
Amr-A	0.20	18	0.36	0.2
Eur-A	0.20	18	0.36	0.2
Wpr-B3	0.30	6	0.18	0.1
World	0.57	12.3	0.70	0.4

^aAfr: WHO African Region, Amr: WHO American Region, Emr: WHO Eastern Mediterranean Region, Eur: WHO European Region, Sear: WHO South-East Asian Region, Wpr: WHO Western Pacific Region, ^bA=Mortality stratum 0.1%, B or C = mortality stratum 0.15%, D or E = mortality stratum 0.2%, WHO: World Health Organization

people world-wide would have glaucoma by 2010, increasing by 20 million by 2020. The Africa region also has the highest incidence and prevalence of glaucoma³ (Adapted from Quigley, 2006)³ [Figure 1]. The prevalence of glaucoma is similar among the Caucasian populations of Europe,⁴ USA^{5,6} and Australia^{7,8} being less than the prevalence in Latinos in the USA⁹ and people of Asian origin.¹⁰⁻¹⁷ The black populations of the Caribbean,^{18,19} Africa²⁰⁻²³ and USA⁵ have the highest prevalence of open-angle glaucoma (OAG).²⁴⁻²⁶ Furthermore, there appear to be differences in the prevalence of glaucoma in different black populations in the Caribbean islands and within Africa,²⁴ which may be attributed to genetic diversity as well as environmental and socio-economic factors.^{27,28}

Who goes blind from glaucoma is influenced by the age of onset of glaucoma and the natural history²⁹ as well as access to services,³⁰⁻³³ the quality of care provided³⁴ and adherence to treatment and follow-up.^{32,33} There is some evidence that glaucoma has an earlier age of onset in blacks^{5,35} and has a more aggressive clinical course.^{34,36,37} In Africa, there are the additional factors of poor awareness,³⁸⁻⁴⁵ poor access to care, and less than optimal diagnosis and management.⁴⁶⁻⁵³ Socio-economic deprivation exacerbates the situation, leading to very late presentation.⁵⁴⁻⁵⁹ Indeed, in Africa, glaucoma has been referred to as the “silent thief of sight.”⁶⁰

Lately, there has been increased momentum about glaucoma care in Africa. At the World Glaucoma Association 1st Africa glaucoma summit in Ghana in 2010, a decision was made to strengthen and incorporate glaucoma management, training and education into existing programs.⁶¹ The Kampala resolution in 2012 called upon all those involved in glaucoma management “to highlight

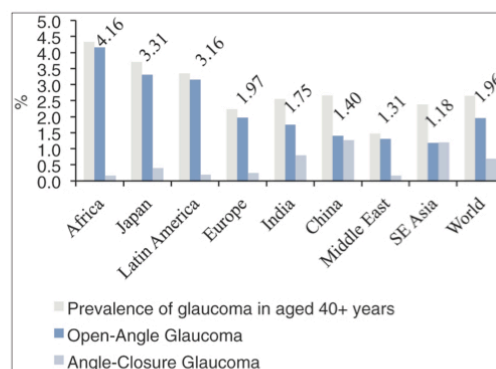


Figure 1: Prevalence of glaucoma in population aged 40+ years (%) in 2010 by World Health Organization sub-regions (Labeled figures indicate percentage values for prevalence of primary open angle glaucoma)

the importance of controlling vision loss from glaucoma as an integral part of eye healthcare and in health and safety policies.”⁶²

The purpose of this review is to describe the epidemiology of the different types of glaucoma in Sub-Saharan Africa (SSA). The scope of the review encompasses published data on the prevalence and incidence of glaucoma and discusses the evidence regarding risk factors for the onset and progression of glaucoma, including risk factors for glaucoma blindness. The designation SSA refers to the geographical area of Africa that lies south of the Sahara desert including Sudan and comprises 48 countries⁶³ and this review also included studies of other black populations outside SSA.

Studying glaucoma in populations has public health implications

as it allows identification of potential risk factors for the disease as well as the blinding consequences, enabling control strategies to be targeted to groups most at risk. These, together with clinical intervention studies, inform diagnostic and therapeutic approaches that can be applied to patients with glaucoma, hence contributing to the Kampala resolutions.

DEFINITIONS

Glaucoma is an optic neuropathy associated with characteristic structural damage to the optic nerve and associated visual dysfunction,⁶⁴ which are seen clinically as enlargement of the optic disc cup and loss of field of vision. It is classified according to the anterior chamber angle morphology into OAG or angle-closure glaucoma (ACG). The morphological classification is very important because the types have different characteristics and present in varying proportions in different populations. OAG and ACG have different natural histories and risk factors and require different management strategies, hence the importance of gonioscopy in the classification of glaucoma. A further classification is by etiology into primary or secondary glaucoma.

A standard definition and classification system for glaucoma was proposed in 1998 by the International Society of Geographical and Epidemiological Ophthalmology (ISGEO)⁶⁴ principally for use in population-based prevalence. The definition considers glaucoma as a group of diseases defined by end-organ (optic nerve) structural damage and functional deficit. In the ISGEO classification, glaucoma is defined by three levels of evidence, regardless of angle morphology (from Foster, 2000)⁶⁴ [Table 2]. The highest level of evidence is when both structural damage and functional deficit are seen; that is a large vertical cup:disc ratio (VCDR) and/or asymmetry between the two eyes. A large disc is defined by the distribution of cup:disc ratios in the normal population, an abnormally large disc being defined when it is $\geq 97.5^{\text{th}}$ percentile of the VCDRs of the normal population. The 1st level evidence also requires characteristic defects in the visual fields (VF). The 2nd level requires greater structural damage of the optic disc (i.e., VCDR $\geq 99.5^{\text{th}}$ percentile, or asymmetry) when VF testing is not possible. The 3rd level is where VCDRs cannot be assessed and VF testing is not possible and the diagnosis of glaucoma is based on other clinical parameters: most importantly, intraocular pressure (IOP), visual acuity of less than 3/60 on the Snellen's chart and medical history (e.g., previous glaucoma surgery).

METHODS

Search methods

Electronic databases (PubMed, Medline, African Journals Online- AJOL) were searched using the full text, Medical Subject Headings (MeSH) terms, author(s) and title to identify the relevant publications. The search terms used were glaucoma, prevalence (in title), Africa (and names of each of the countries) open-angle, angle-closure, blindness, and visual impairment. The search was restricted to publications in the last three decades (from 1982 to 2012) and papers and/or abstracts available in English. The following publications were included: (1) population-based glaucoma prevalence surveys in SSA; (2) population-based glaucoma prevalence surveys or incidence studies in African-derived black populations living outside Africa; (3) population-based prevalence surveys and/or incidence studies of blindness and visual impairment studies in SSA, including rapid assessment methods, which elucidate the cause-specific blindness prevalence due to glaucoma; (4) PBS in SSA and African-derived black populations, which reported risk factors for glaucoma and/or glaucoma blindness; and (5) publications that discussed public health approaches for the control of glaucoma in Africa. Reference lists of cited articles were searched for additional publications not identified by the database searches.

PBS of blindness and visual impairment and rapid assessment of avoidable blindness (RAAB) surveys that did not have data on the proportion of visual impairment or blindness due to glaucoma were excluded. Hospital/facility-based studies were not included.

Strengthening the reporting of observational studies in epidemiology (STROBE) guidelines

Population-based glaucoma prevalence surveys in SSA and black populations living outside Africa were critically appraised using the STROBE guidelines.^{65,66} These guidelines are to assess the clarity of reporting in relation to completeness and accuracy, but are not designed to assess the quality of the research. The completeness and accuracy of the reports aided the interpretation and the generalizability of the results. The 22 key points enumerated on the STROBE checklist for cross-sectional studies were assigned one score each. Some of the key points appraised included: "presenting key elements of study design early in the paper; describing the setting, locations, and relevant

Table 2: ISGEO definition for glaucoma in prevalence surveys

Level of evidence for the diagnosis of glaucoma	Parameter			VA	Medical history
	VCDR	VF	IOP		
Level 1	$\geq 97.5^{\text{th}}$ %	Typical defect			
Level 2	$\geq 99.5^{\text{th}}$ %	Not available			
Level 3	Not available	Not available	$\geq 99.5^{\text{th}}$ %	<3/60	e.g., Surgery for glaucoma

ISGEO: International society of geographical and epidemiological ophthalmology, VCDR: Vertical cup:disc ratio, VF: Visual fields, IOP: Intraocular pressure, VA: Visual acuity

dates, including periods of recruitment, exposure, follow-up, and data collection; mentioning the eligibility criteria, and the sources and methods of selection of participants; clarity on diagnostic criteria; describing all statistical methods, including those used to control for confounding; reporting numbers of individuals at each stage of the study—e.g., numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analyzed; reporting other analyses carried out.⁷⁹ A numerical summary score was given to each of the publications and an arbitrary classification was applied. Papers that scored >75% were classified as good, those that scored 55–75% were classified as satisfactory and those that scored <55% were classified as incomplete.

RESULTS

Search results summary

PBS of glaucoma in SSA

A total of nine studies^{20–23,67–71} were identified and all were included [Table 3]. Using the STROBE guidelines,^{65,66} three were classified as good,^{20–22} one was satisfactory⁶⁷ and five had incomplete reporting.^{23,68–71}

PBS of glaucoma in African-derived populations living outside Africa

Four glaucoma prevalence studies^{5,18,19,72} [Table 3] and one glaucoma incidence study⁷³ were included in the review. Using the STROBE guidelines, three surveys were classified as good.^{5,18,19}

PBS of prevalence/incidence of blindness and visual impairment in SSA

Fifty-five publications were identified. Of these, 32 prevalence surveys^{74–105} [Table 4] and the only incidence study identified¹⁰⁶ were included in this review. Glaucoma was not clearly defined and/or was not mentioned as a specific cause of blindness in the other PBS of prevalence and RAAB publications.^{107–128}

Population-based studies that reported risk factors for glaucoma in SSA and African-derived populations

One report on risk for incident open-angle glaucoma¹²⁹ and 10 further publications that discuss risk factors for glaucoma were included in this review.^{130–139}

Prevalence of glaucoma

There are few PBS data that provide prevalence estimates of any/all types of glaucoma in SSA^{20–23,67–69} [Table 3], and only four provided reliable estimates.^{20–22,67} Of these, three were undertaken in different districts in South Africa^{21,22,67} and one in the Kongwa region of Tanzania.²⁰

The surveys in Kongwa, Tanzania,²⁰ Hlabisa, South Africa²¹ and Temba, South Africa²² conducted the study on people aged 40 years and above; had robust methodologies, with a

well-described sampling strategy, and detailed descriptions of IOP measurement and VF assessment. Gonioscopy and optic disc examination methods were clearly described. Two of the surveys^{21,22} were analyzed using the ISGEO classification⁶⁴ and IOP was included as a diagnostic criterion only when optic discs could not be assessed and VFs were not obtainable. The prevalence estimates of all types of glaucoma were 4.5% (95% confidence interval [CI] 3.2–6.1%) and 5.3% (CI 3.9–7.1%) respectively. The other study in Mamre, South Africa⁶⁷ also studied those aged 40 years and above. The prevalence estimate was similar (4.6%; CI not reported) but the methodology was less rigorous. The survey in Kongwa, Tanzania²⁰ used three diagnostic criteria based on the optic disc and VF definitions. When definite field defects in association with compatible disc changes were used to define glaucoma, the prevalence of all types of glaucoma was 4.16% (CI 3.5–4.9%).

The other studies used different methods and had limitations, which may have affected the estimate of glaucoma. For example, a survey in south-eastern Nigeria⁶⁹ used IOP as a major diagnostic criterion and disc assessment was performed by direct ophthalmoscopy through an undilated pupil. In this survey, the prevalence of glaucoma was 2.1% (CI not reported) in people 30 years and older. In northern Nigeria,⁶⁸ a survey of individuals aged 5 years and above reported the prevalence of glaucoma to be only 0.55% (CI 0.07–1.99%) in the 361 participants examined aged 35 years and above; and 1.02% (CI 0.12–3.64%) in the 196 participants aged 45 years and older. Glaucoma was defined based on typical glaucomatous disc appearance or IOP greater than 30 mmHg if the disc was not visualized. A further survey in southern Ghana,²³ which used European glaucoma study guidelines, did not use stringent diagnostic criteria, and those with media opacities with no view of the disc were excluded. Another limitation was the sampling strategy, which was largely a volunteer sample and included family members of those with a positive family history of glaucoma. In this survey, the prevalence of OAG was 8.4% (CI 7.74–9.06%) in those 30 years and older, which is likely to be an over estimate. A study reported from western Cameroon,⁷¹ which also used a voluntary sample, reported the prevalence of glaucoma to be 8.2% (CI not reported). Another study in Nigeria⁷⁰ excluded persons with IOP greater than 21 mmHg and did not assess VFs. In this survey, the prevalence of glaucoma suspects was 2.7% (CI not given). Previous authors suggested in 2009 that a conservative estimate of the prevalence of glaucoma in Africa in people 40 years and older be 4%.⁴⁶

There have been four glaucoma surveys among black populations living outside Africa [Table 3]. In the Caribbean region, the prevalence of glaucoma in African-Caribbeans was 8.8% (CI not given) in those aged 30 years and above in St Lucia¹⁸ and 6.8% (CI 6.1–7.6%) in aged 40 years and above in Barbados.¹⁹ In African-Americans in Baltimore, USA⁵ the glaucoma prevalence

Table 3: Population-based surveys of glaucoma by types and racial origin												
Racial origin/Ethnic group	Year	Location of study	Age (years)	Examined/ Sample size (Response rate %)	Prevalence of glaucoma ^a			Other forms of glaucoma (%)	Un-diagnosed glaucoma (%)	Proportion blind ^d (%)	Clarity of reporting using STROBE checklist ^e	Reference
					All glaucoma (%)	POAG (%)	PACG (%)					
African												
Bantu (Wagogo)	2000	Kongwa, Tanzania	40+	3247/3641 (89.2)	4.16	3.10	0.59	0.49	98.5	14.1	Good	[20]
Bantu (Zulu)	2002	Hlabisa, South Africa	40+	1005/1115 (90.1)	4.50	2.70	0.10	1.70	90.2		Good	[21]*
Bantu (Sotho and Nguni)	2003	Temba, South Africa	40+	839/1120 (74.9)	5.30	2.90	0.50	2.00	87.1 (of POAG)	41 (of eyes with POAG)	Good	[22]*
SE Asian and W European	1993	Mamre, South Africa	40+	987/1194 (82.7)	4.66	1.52	2.33	0.81 (angle recession)	78.3	33 (of POAG)	Satisfactory	[67]
Hausa-Fulani	2001	Kaduna, Nigeria	35+	361/430 (83.9)	0.55	0.55	-	-	-	15.2	Incomplete	[68]
			45+	196/239 (82.0)	1.02	1.02	-	-	85.7	-	Incomplete	[69]
Ibo	2002	Enugu, Nigeria	30+	664/946 (70.0)	2.10	-	-	-	-	-	-	
			40+		2.78							
Akwapim, Ewe, Akim, Ga-Adangbe	2004	Akwapim-South, Ghana	30+	1785/1843 (96.9)	7.7 [§]	8.40	0.50	-	93.0	-	Incomplete	[23]
Ekpeye (Igbo extraction)	2009	Rivers, Nigeria	All ages	866/960 (89.0)	2.7 (glaucoma suspects)	-	-	-	-	9.5	Incomplete	[70]
Bamileke; Bamum	2009	Western Cameroon	5 to 90	635/-	-	8.20	-	-	-	-	Incomplete	[71]
African-derived												
African-Caribbean	1989	St. Lucia	30+	1679	8.8	-	-	-	-	-	Good	[18]
African-American	1991	Baltimore	40+	5308/5023 (94.6)	-	Blacks 4.74 [§] Whites 1.29 [§]	-	-	About half	5.3 (of POAG)	Good	[5]
African-Caribbean; mixed	1994	Barbados	40+	4709/5640 (83.5)	-	All 7.1 [§] Blacks and mixed 6.8 [§] Whites 0.8	-	0.7	51.0	-	Good	[19]
African-Caribbean	1994	London	35+	873/-	3.9	-	-	-	58.0	0	Incomplete	[72]

^aAdjusted rates if reported, ^bProportion of glaucoma participants that are blind, ^cOutcome of appraisal by adequately including STROBE key points: >75% good, 55-75% satisfactory, <55% incomplete ^dSurvey conducted according to ISGEO criteria for glaucoma definition, ISGEO: International society of geographical and epidemiological ophthalmology, POAG: Primary open angle glaucoma, STROBE: Strengthening the reporting of observational studies in epidemiology

^aAdjusted rates if reported, ^bProportion of glaucoma participants that are blind, ^cOutcome of appraisal by adequately including STROBE key points: >75% good, 55-75% satisfactory, <55% incomplete ^dSurvey conducted according to ISGEO criteria for glaucoma definition, ISGEO: International society of geographical and epidemiological ophthalmology, POAG: Primary open angle glaucoma, PACG: Primary angle-closure glaucoma, STROBE: Strengthening the reporting of observational studies in epidemiology

Table 4: Glaucoma cause-specific blindness prevalence and proportion of blindness due to glaucoma as percentage of total blindness in SSA

Location/Country of study	Year	Age (years)	Examined Sample	Blindness prevalence, all causes (%)	Proportion of blindness due to glaucoma (%)	Ranking of blindness due to glaucoma	Glaucoma blindness prevalence in study population (%)	Glaucoma blindness prevalence in 40+ year olds	Reference
South Africa	2003	40+	839	5.60	32.0	2	1.79	1.79	[22]
Cameroon	2007	40+	2215	4.10	29.0	1	1.19	1.19	[74]
South Africa	2002	40+	1005	3.20	22.0	2	0.90	0.90	[14]
Nigeria, national	2009	40+	13,599	4.20	16.7	2	0.70	0.70	[75]a
Ethiopia	2003	40+	2693	7.90	7.7	3	0.61	0.61	[76]
Ghana	2005	40+	2298	2.80	20.6	2	0.58	0.58	[77]a
Ghana	2012	40+	5603	1.20	21.7	3	0.26	0.26	[78]a
Eritrea	2011	50+	3163	9.00	15.2	2	1.37	0.80	[79]
Liberia	2012	50+	3,544	4.10	16.0	2	0.66	0.38	[80]
Malawi	2011	50+	3430	3.30	15.8	2	0.52	0.30	[81]
Nigeria	2006	60+	445	5.60	42.0	2	2.35	0.70	[82]
Nigeria	2005	30+	480	10.40	6.0	4	0.62	1.02	[83]
Equatorial Guinea	2002	All	3218	3.20	13.3	4	0.43	2.36	[84]
Nigeria	2007	8 to 92	2201	1.20	33.3	2	0.40	1.54	[85]
Nigeria	2003	All	1964	1.22	20.8	3	0.25	0.25	[86]
South Africa	1993	All	6090	1.00	22.9	2	0.23	1.27	[87]
Ethiopia	1995	All	60,820	1.10	17.0	4	0.19	1.04	[88]
Nigeria	2004	All	-	1.18	15.8	3	0.19	1.04	[89]
Malawi	1986	6+	1574	1.27	-	3	0.19	0.90	[90]
Nigeria	2007	All	1248	1.10	14.3	2	0.16	0.87	[91]
Uganda	2002	13+	4076	0.40	38.5	1	0.15	0.53	[92]
Cameroon	1996	All	10,647	1.20	12.0	2	0.14	0.80	[93]
Mali	1996	All	5871	1.70	8.1	3	0.14	0.77	[94]
Cape Verde	2006	All	3374	0.80	15.4	2	0.12	0.68	[95]
Nigeria	1996	All	2921	0.90	11.1	3	0.10	0.56	[96]
Benin	1995	All	7047	0.60	15.0	2	0.09	0.50	[97]
Ethiopia	1997	All	7423	0.85	9.5	3	0.08	0.45	[98]
Kenya	1990	All	13,803	0.70	-	3	0.06	0.33	[99]
Central African Republic	1997	All	6086	2.20	2.2	4	0.05	0.27	[100]
Togo	1989	All	11,081	0.82	6.0	3	0.05	0.27	[101]
Gambia	2000	5+	13,046	0.42	9.0	3	0.04	0.18	[102]a
South Africa	1988	All	18,962	0.57	6.0	4	0.03	0.19	[103]
Congo	1990	All	7041	0.30	9.0	2	0.03	0.15	[104]
Gambia	1989	All	8174	0.70	2.0	-	0.01	0.08	[105]

40+ year-olds as 18% of the total population, 50+ year-olds as 10.5% of the total population, *Visual field examination done, SSA: Sub-Saharan Africa

in those aged 40 years and above was 4.74% (CI 3.81-5.67%) among blacks, being four times higher than in whites (1.29%, CI 0.80-1.78). A prevalence of 3.9% (CI not given) was reported in a cross-sectional study of a voluntary sample of African and Caribbean people aged 35 years and above living in London.⁷²

The prevalence of glaucoma in the studied populations aged 40 years and older in the Tanzania²⁰ and South Africa^{21,22,67} surveys (range 4.2% to 5.3%) was comparable to the 4.2% prevalence in the African-American population of Baltimore,⁵ but much lower than the prevalence of 7.1% in the African-Caribbean population of Barbados.¹⁹ Although these surveys were not completely comparable as the definitions of glaucoma varied and the methodology was not uniform, a consistent pattern was revealed: that glaucoma is a public health problem in SSA.

Types of glaucoma

Where glaucoma was classified by angle morphology, OAG was approximately six times more prevalent than ACG in SSA²⁰⁻²³ [Table 3]. The exception was a study in those of mixed South-East Asian and western European origin in Mamre, South Africa.⁶⁷ In this study, Salmon reported a prevalence of 2.3% for ACG and 1.5% for OAG. However, 12 participants (1.2%) had full VFs and were classified as having ACG on the basis of their angle configuration only, without evidence of functional deficit. If the ISGEO definition of functional visual deficit had been used the prevalence estimate for ACG would have been lower. Nonetheless, the findings indicate that in SSA, ACG is more prevalent in those of SE Asian origin than in blacks. Pseudoexfoliation, aphakic glaucoma, uveitic glaucoma, lens-induced, and post-traumatic angle-recession glaucoma were

classified as secondary glaucoma,^{20-22,67} with the prevalence ranging from 0.49% in Kongwa, Tanzania²⁰ to 2.0% in Temba, South Africa.²² Exfoliative glaucoma was responsible for 16% of all glaucoma in Temba²² and 21.6% of all glaucoma in Hlabisa in South Africa,²¹ but was not detected in Kongwa, Tanzania.²⁰

The publications for the surveys in the African-derived populations living outside Africa were reports for OAG and did not give prevalence of other types of glaucoma except in Barbados where the prevalence of secondary glaucoma was 0.7%.¹⁹

Incidence of glaucoma

Incidence rates provide evidence of long-term risk of a disease and are important for planning services and for policy. The cumulative incidence is the number of new cases seen over the time of observation divided by the population at risk. There are no PBS that report observed incidence of glaucoma in SSA. In the African-descent population of Barbados, the 9-year incidence of definite OAG was 4.4% (CI 3.7-5.2%) or 0.5%/year and showed an increased risk with age and in men.⁷³

Awareness of glaucoma

A total of nine surveys reported whether or not participants with glaucoma knew they had the disease or if they were receiving treatment [Table 3]. In Kongwa, Tanzania,²⁰ 98.5% did not know they had the disease. Similarly, 90.2% in Hlabisa, South Africa²¹ and 87.1% (of those with Primary OAG) in Temba, South Africa²² were not aware they had the disease. In Mamre, South Africa,⁶⁷ 36 (78.3%) were newly diagnosed and another six out of the seven participants that were blind due to glaucoma were already receiving treatment. Ninety-three per cent in Akwapim-South²³ and 85.7% in Enugu, Nigeria⁶⁹ were newly diagnosed. Approximately, half in both racial groups (blacks and whites) in Baltimore⁵ as well as in Barbados¹⁹ did not know they had the disease.

Glaucoma blindness

Incidence of glaucoma blindness

In Uganda, the all-cause incidence of blindness was 9.9/1000 person years, with glaucoma accounting for 3.6% of incident cases (i.e., 0.36/1000 person years).¹⁰⁶ In the Barbados eye studies, OAG was the 2nd leading cause of incident blindness, accounting for 14.3% of the 9-year incidence (1%) i.e., 0.143% over 9 years.¹⁴⁰

Proportion of people with glaucoma who are blind

The only SSA glaucoma prevalence surveys, which reported the proportion of participants with glaucoma who were blind were those conducted in Tanzania, South Africa and Ghana. The proportions were as follows: 14.1% in Kongwa, Tanzania,²⁰ 33% (of OAG) in Temba, South Africa,²² 15.2% in Mamre, South Africa,⁶⁷ and 9.5% in Akwapim-south, Ghana.²³ In the Temba survey, 58% (32 of 55) of those with any type glaucoma were

blind in at least one eye.²² In Hlabisa, South Africa study, 41% of eyes with OAG were blind.²¹

In the Baltimore eye survey, the proportion of participants with OAG who were blind was 5.3%.^{5,141}

Glaucoma-specific blindness prevalence

Data on the glaucoma cause-specific blindness prevalence were available from the following sources: PBS of blindness and visual impairment, RAAB studies and World Health Organization (WHO) published data.

From the available data, the glaucoma-specific blindness prevalence was calculated for those aged ≥ 40 years, assumed to be 18% of the total population [Table 4]. In the seven surveys in which the studied populations were aged 40 years and older,^{21,22,74-78} the glaucoma-specific blindness prevalence ranged from 0.26% in Ghana⁷⁸ to 1.79% in Temba, South Africa.²² In the recent RAAB studies conducted in Eritrea,⁷⁹ Liberia⁸⁰ and Malawi,⁸¹ the glaucoma blindness prevalence in the study population of 50-year olds and above were 1.37%, 0.66% and 0.52%, respectively. Glaucoma was the second or leading cause of blindness^{74,92} in the more recent surveys, but ranked third of fourth in older surveys, after cataract and corneal diseases. However, in all the surveys included in this review, only six had VF assessment as part of the examination protocol.^{75,77,78,102,109,126} In all the other surveys, glaucoma was diagnosed only as a cause of blindness and only included those who had lost central fixation in both eyes.

In Hlabisa, South Africa, the prevalence of blindness was 3.2% (CI 2.2-4.6%) in people aged 40 years and above, and 22% was due to glaucoma.²¹ In Temba, South Africa, the prevalence of blindness was 5.6% (CI 3.9-7.7%) in people 40 years and older and the proportion due to glaucoma was 32%.²²

A recent nationally representative population based survey of blindness and visual impairment in Nigeria reported the all-cause prevalence of blindness to be 4.2% (CI 3.8-4.6%)¹⁴² and the proportion of blindness due to glaucoma was 16.7% among those aged ≥ 40 years.⁷⁵ The prevalence of blindness ranged from 3.3% (CI 2.4-4.5%) in the Delta ecological zone to 6.6% (CI 4.2-10.4%) in the northern Sahel ecological zone, and the proportion of blindness due to glaucoma varied from 13.2% in the Sudan Savannah to 23.5% in the Sahel ecological zones. The nationwide overall glaucoma-specific blindness prevalence was 0.7% (CI 0.55-0.88%)⁷⁵ with a four-fold difference in the glaucoma-specific blindness prevalence which ranged from 0.4% (CI 0.2-0.9) in the Delta to 1.6% (CI 0.6-3.8%) in the Sahel.¹⁴³ A high prevalence of blindness in all ages was reported in Bioko, Equatorial Guinea (3.2%)⁸⁴ and this was reflected as high prevalence estimate of glaucoma blindness of 2.36% in the 40+ year-olds. A high prevalence of blindness (10.4% in people

30 years and older) was reported in a survey in leprosy villages in north-eastern Nigeria, where glaucoma ranked 4th as a cause of blindness, nevertheless, with a high glaucoma-specific blindness prevalence of 1.02% in the 40+ year-olds.⁸³ This is in contrast to a survey undertaken decades ago in an area endemic for onchocerciasis in North-Eastern Nigeria where the prevalence of blindness was 11.8% in all ages and glaucoma did not feature as a cause as almost all blindness was due to onchocerciasis.¹²⁸

In the Baltimore eye survey,¹⁴¹ the overall prevalence of blindness was 1.21% and the proportion of blindness due to glaucoma was 14.1% among those aged 40 years and above. The glaucoma-specific blindness prevalence was 0.17%. Glaucoma blindness was compared between whites and blacks. In the blacks, glaucoma blindness was 0.37% and 6.6 times higher than the 0.06% glaucoma blindness prevalence in whites. Glaucoma blindness also occurred earlier in blacks with a prevalence of 0.29% in the age-group 50-59 years whereas none of the whites were blind due to glaucoma before the age of 60 years. In this population, glaucoma as well as cataract and diabetic retinopathy were more common as a cause of visual impairment in blacks while macular degeneration was more so in whites.¹⁴⁴

Data on the prevalence and causes of blindness were published by WHO for the year 2002.² Survey data available at the time were extrapolated to countries without data in order to derive global estimates. The glaucoma-specific blindness prevalence was calculated from these data, which are presented according to the 17 WHO sub-regions [Table 1]. The proportion of blindness in all ages due to glaucoma globally was 0.7/1000, ranging from 0.18/1000 in the Western Pacific sub-region B3 to 1.5/1000 in both African sub-regions. Glaucoma blindness in Africa is, therefore, twice the global figure; and eight times higher than in the Western Pacific sub-region.

Risk factors

The study of risk factors gives information on who gets glaucoma (incidence studies), who has glaucoma (prevalence studies), who progresses and who goes blind due to glaucoma (risk of progression, prognostic factors). Risk factors for glaucoma incidence were reported from the Barbados eye study.¹²⁹ Risk factors for glaucoma prevalence were reported in six of the PBS of glaucoma in SSA^{20-23,67,69} and in all four of the PBS of glaucoma in the African-derived populations.^{5,18,19,72} Ten other publications related to the Akwapim-South, Ghana survey,¹³⁹ St Lucia survey,¹³⁷ Barbados eye study,¹³⁰ Baltimore eye survey,^{132,133,135,136} African descent and glaucoma evaluation study,¹³⁴ a multicenter study¹³⁸ and a PBS in African-Americans living in Canada¹³¹ reported risk factors for glaucoma.

Who is at risk of developing glaucoma?

Risk factors for incident OAG were increasing age, higher IOP

lower systolic blood pressure (BP) to IOP ratio (BP/IOP), lower mean diastolic ocular perfusion pressure (diastolic BP minus IOP), thinner central corneal thickness (CCT), and a positive family history.¹²⁹ Racial variability of some of these risk factors at baseline has been demonstrated;¹³⁰ with higher IOP¹³¹ and thinner CCT^{131,134} in African-derived groups.

Who has glaucoma?

Age was an important and consistent risk factor, with a higher prevalence of glaucoma associated with increasing age.^{5,19-23,69,72,130} The age-specific prevalence of OAG was higher with increasing age: From 1.7% (CI 1.1-2.5%) to 5.6% (CI 3.1-9.2) in Kongwa, Tanzania,²⁰ from 1.2% (no CI reported) to 4.9% in Hlabisa, South Africa,²¹ and from 0.6% (no CI reported) to 6.0% in Temba, South Africa,²² in the age-group 40-49 years and the age-group 70-79 years, respectively. Similarly, higher prevalence of OAG was reported from 1.4% (CI 0.8-2.2%) to 14.8% (CI 12.5-17.4%) in Barbados,¹⁹ and from 1.23% (CI 0.23-2.24%) to 9.15% (CI 5.83-12.48%) in blacks and from 0.92% (CI 0.2-7.2%) to 2.89% (CI 1.44-4.34%) in whites in the Baltimore eye survey,⁵ in the age-groups 40-49 years and 70-79 years, respectively.

Gender was not consistently associated with prevalent cases of glaucoma.^{5,23,69} However, some surveys reported a higher prevalence of OAG in men.^{19,21,22,67,130} Men were also more likely to have secondary glaucoma,²² especially following trauma.⁶⁷ ACG was more common in women.⁶⁷

Higher IOP is another important factor associated with a higher prevalence of glaucoma,^{20,21,130,132} although IOP had a limited predictive value.²¹ Hypertension was not significantly associated with glaucoma prevalence.^{20,72,130} However, lower mean ocular perfusion pressure was associated with a higher prevalence in the surveys in African-derived populations of Barbados¹³⁰ and Baltimore¹³⁵ but, this was not reported in African-Caribbeans in London⁷² or in the only survey that this factor was studied in SSA.²⁰ These factors associated with ocular blood flow i.e., systolic BP, diastolic BP and ocular perfusion pressure were stronger in older people.^{132,133,135}

A positive family history of glaucoma was associated with higher prevalence of glaucoma.^{130,133}

The higher prevalence of glaucoma in blacks compared to whites was consistently demonstrated in the surveys involving the two racial groups.^{5,19,72} Furthermore, those with darker skin and of African birth seemed to have a higher risk.⁷² However, in the two studies involving a number of ethnic groups in SSA, ethnicity was not associated with a variation in prevalence of glaucoma;^{22,23} but the sample sizes were relatively small and the studies were confined to limited geographical areas with few ethnic groups represented.

Other risk factors for glaucoma include lower body mass index in men and history of cataract surgery.¹³⁰

Who has glaucoma progression and who develops blindness due to glaucoma?

A survey in Ghana¹³⁹ explored the risk factors associated with severe disease and surveys in Baltimore¹³² and St Lucia¹³⁷ explored the risk factors for glaucoma progression and blindness. The Temba, South Africa survey²² was the only SSA survey that described the age of participants that were blind due to glaucoma. The risk of glaucoma blindness increased with increasing age. The average age of the blind glaucoma participants was higher (74.8 years) when compared to the average age (65.4 years) of the non-blind participants. In the Ghana study that combined population-based and facility-based samples, older age (more than 60 years) and IOP greater than 31 mmHg were associated with more severe disease and the absence of family history was associated with delay in seeking treatment.¹³⁹ Increasing age was also associated with progression of the disease.^{136,137} Aggressive glaucoma therapy reduces the progression of VF loss that leads to bilateral blindness;¹³⁶ and the proportion of patients with progressive VF loss is much higher in those untreated than in treated eyes.¹³⁷ Glaucoma progression was more severe in blacks¹³⁸ and blindness occurred at an earlier age in blacks than in whites.¹⁴¹

DISCUSSION

World estimates on the prevalence of glaucoma and glaucoma blindness prevalence have been derived from projections and modeling from pooled data and surveys,³ and by extrapolating data from countries with data to those without,² and more recently, using newly developed imputation methods based on country economic status.¹ However, these approaches have given different estimates for glaucoma. One explanation for the WHO estimates of glaucoma blindness being lower than other estimates is that data were obtained from population based surveys of blindness, where VF are usually not included in the definition of blindness. Individuals with extensive VF loss, but with preserved central fixation in at least one eye would not, therefore, be included in the WHO estimates. Another reason may be that age-standardization is included in modeling estimates and this will take into account the steep decline in population after age 40 years that is typical of developing country profile.

The number of high quality glaucoma surveys conducted in Africa is low and it is difficult to extrapolate the findings to wider populations as they were conducted in limited and defined geographical areas of large countries. These surveys were also often not directly comparable due to variation in the age of participants, and differences in the methods used to measure parameters of relevance to glaucoma and to define and classify the disease. Only two surveys used the ISGEO definition, which relates IOP and cup:disc ratios to population norms. This is

important, given the recognized variation in the distribution of optic disc and cup size and IOP between populations.^{12-16,64,145-149} There is only one small study of the incidence of glaucoma blindness in Africa,¹⁰⁶ and no studies on the incidence of glaucoma. Longitudinal studies to address these questions will also give information on the natural history of the disease, as a high proportion of individuals diagnosed with glaucoma do not seek treatment even when this is recommended.

More reliable data are required from large scale, rigorous PBS in order to revise and refine the prevalence and magnitude estimates of glaucoma and glaucoma blindness for SSA. Ideally, the surveys should use the same age range, and the standard definitions and classification system, and use comparable methods of assessing VF, IOP and cup:disc ratios. The sample sizes should be large enough to allow analysis of risk factors for glaucoma in order to identify the population most at risk. Ideally, such surveys should also collect data on family history of glaucoma and socio-demographic data. Data on whether different ethnic groups in SSA are more at risk than others is currently lacking, as there are no published studies, which have included a large enough sample of different ethnic groups. The relatively small sample size of the reviewed surveys would limit the power of the studies to detect differences. Data from the Nigeria national survey¹⁵⁰ are currently being analyzed and will provide data on risk factors including variations in ethnic groups. Again, this information would be of value for targeting control strategies.

The suggested prevalence of glaucoma in SSA of 4% in people 40 years and older⁴⁶ is a reasonable estimate as that is what these three "good" studies in SSA indicated.²⁰⁻²² Since, this prevalence estimate was suggested in 2009 for Vision 2020 planning purposes, there has been no additional high quality data to suggest that it needs to be changed.

The available evidence suggests that the prevalence of glaucoma is higher in SSA and in people of African descent who live outside Africa. A Bayesian meta-analysis that examined the relationship between OAG prevalence and age, gender, and racial group also showed that the pooled random effects prevalence of OAG was higher in the black populations (4.2%).²⁶ Given the lack of evidence that environmental and behavioral risk factors are associated with glaucoma, these findings suggest a genetic basis for the greater susceptibility in blacks.²⁸ The genetic basis of glaucoma is being increasingly recognised^{151,152} and genetic research and genome-wide association studies in Africa will possibly explain some of the variations and excess risk seen in black populations.

The most prevalent type of glaucoma in SSA is open-angle glaucoma. However, hospital-based studies tend to overestimate the proportion of ACG reporting a range of 6% to 18% of all glaucoma cases seen;^{54,153-157} and this may be related to the

health-seeking behavior in which the pain in acute ACG acts as a trigger for the need to obtain treatment.

The very low awareness of having the disease as reported in the PBS signifies that only a small fraction of people with glaucoma access healthcare, leaving a large majority untreated and with the potential blinding effects. Indeed, in those that access healthcare, up to 42% of glaucoma patients presented with advanced disease and bilateral blindness; and over half were blind in one eye.⁵⁴⁻⁵⁹

Glaucoma causes irreversible blindness due to loss of ganglion cells of the optic nerve leading to vision and VF loss. The proportion of people with glaucoma who are blind is higher in SSA than in any other region. The earlier age of onset of the disease in blacks has already been reported³⁵ and this has been corroborated in the PBS in SSA²⁰⁻²² and black populations where the prevalence of OAG in the age-group 40-49 years was much higher than in white populations of USA and Barbados.^{5,19} Interestingly, a similar variation of the 40-49 years age-specific prevalence of 0.4% (CI 0.0-0.9%) and 3.1% (CI 0.4-5.8%) between the white and non-white groups, respectively, in Piraquara City, Brazil was reported.¹⁵⁸ Comparatively, the 40-49 years age-specific prevalence in Caucasian Australians was 0.2% (CI 0.0-0.56%),⁸ and remarkably from as low as <0.2% (no CI reported)¹⁵⁹ and up to 1.5% (CI 0.4-2.5%)¹⁶⁰ in indigenous Australians. Glaucoma progression is also more aggressive in blacks.^{36,37,138} Thus one of the plausible reasons why blacks in Africa and African-derived populations have more glaucoma blindness is that the early age of onset means they have the disease for a longer time.

The Nigeria national survey on blindness and visual impairment is the largest PBS that has ever been carried out in Africa. The prevalence data by geo-ecological zones showed wide variation between the Sahel and the Delta ecological zones. The proportion of blindness due to glaucoma was also higher, with a 4-fold difference in the prevalence of glaucoma blindness.¹⁴³ The only explanations are that the incidence of glaucoma blindness is higher and/or the disease is more aggressive and/or access to care is lower in the Sahel zone. Data on these factors are currently being analyzed.

Further studies are needed to explore risk factors for glaucoma blindness, which will help to identify those most at risk for example by gender, socio-economic status (e.g., level of education), age, and ethnic group. Exploration of biomedical risk factors associated with disease progression (e.g., IOP and ocular perfusion pressure) will also provide guidelines for setting and monitoring target IOP following treatment.

The ranking of glaucoma as a major cause of blindness from lower ranks in older surveys to second leading cause in most recent surveys may be attributable to the increase in control efforts

of corneal diseases, notably vitamin A deficiency and trachoma which became less in magnitude, and a decrease in onchocerciasis blindness. In addition, the classification and diagnosis of glaucoma had improved in more recent surveys. However, it is probable that figures for glaucoma prevalence and blindness are underestimations especially in populations with a high prevalence of cataracts. Cataract and corneal diseases are more easily diagnosed in surveys and may occlude the view of the optic disc for a definite diagnosis of glaucoma. Furthermore, in ranking of principal cause of blindness using the WHO format, cataract or corneal scar may take precedence being recorded preventable causes of blindness even in eyes with co-existing glaucoma.

A large number of the PBS from which data of glaucoma-specific blindness prevalence were derived did not have VF assessments. These data therefore underestimate glaucoma-specific blindness which, if using the WHO definition of blindness, should also include those with a central VF of less than 10 degrees in the better eye.¹⁶¹ The wide variation in glaucoma-specific blindness prevalence may be attributable to the sampling methodology and/or some studies done in areas where focal diseases were more prevalent. In addition, the definitions used for blindness as well as for glaucoma and the age of participants in the surveys varied. The age of the sample is very important since the disease is age-related. Even if definitions and measurements were standardized and the sample populations were all 40+ years, there could still be very different prevalence data because of the differences in the life expectancy and age structure of people aged 40 years and above between populations and regions. Age-standardization between the surveys would have eliminated the differences due to confounding by differences in age structure of the populations.

A limitation of this review process is that age-standardization of these data was not possible. Another limitation is that there was a language restriction in the search strategy. If a publication and abstract were not in English they might have been missed. However, this would only apply to Francophone and Lusophone Africa.

Application of these studies to the control of glaucoma in SSA

These studies have highlighted that glaucoma is predominantly OAG and it is a public health problem in SSA. It has a high prevalence, an early onset and progresses more rapidly than in Caucasians; and it is a major cause of blindness. Thus case-finding strategies need to be targeted at younger ages. Treatment needs to be more aggressive, life-long and with adequate follow-up, and monitoring of patient-physician contact frequency.

Challenges for the control of glaucoma in African populations have been elucidated.^{46,47,50,52} The disease is most often diagnosed late and there is a poor response to treatment possibly due to

poor compliance or non-availability of any form of treatment. These factors are further compounded by poor awareness and low knowledge about glaucoma even by patients. Provider factors include poor facilities and equipment for glaucoma diagnosis and management,⁵³ inadequate number of ophthalmologists¹⁶² and support teams and limited treatment options (e.g., lasers and trabeculectomy with adjunctive antimetabolites).

In order to reduce morbidity from glaucoma, a public health approach is needed for control and particularly targeted to those at risk. Possible solutions have been proposed and some are being implemented.^{46,50,61,62,163} Approaches for control include: To increase public health education for awareness about glaucoma; to improve case-detection methods including opportunistic eye examinations; to encourage case-finding in first-degree relatives; to increase treatment options and availability of medications and surgery; to increase education and training for skilled glaucoma surgeons, patients' counselors and other glaucoma care workers; and to strengthen infrastructure of eye care centers and other systems for glaucoma diagnosis, treatment, and counseling of patients. These should be incorporated into existing Vision 2020 programs and blindness control strategies; and glaucoma care needs to be given high priority.

Further research

Despite the many challenges facing SSA, there is a need to streamline glaucoma control activities and provide evidence-based care. The process to undertake such research can be scheduled systematically and tailored according to local needs and available pooled resources. In the longer term, results and output of the research will be beneficial.

Epidemiological research

More population-based research is needed to clarify the nature of glaucoma in many more populations in Africa, to determine reasons for its variation and to better define target risk groups.

Social sciences/qualitative research

This is important in order to identify the factors and barriers to awareness and knowledge of blinding eye diseases; and compliance and adherence to treatment of glaucoma in SSA.

Clinical care and outcomes

Operational and clinical research for patient care is needed to define clinical guidelines (including issues of patient-physician contact frequency) and protocol of management for optimum glaucoma care. Monitoring of outcomes tools including patient reported outcome and experience measures¹⁶⁴ and quality of life and visual function measures need to be developed. Randomized control trials are needed to define appropriate choices of treatment and provide evidence-base for best clinical care.

Health systems research

Studies that also provide evidence for policy makers and

management to facilitate systems for the management of the disease are important.

Health economics research

This will define issues such as cost-benefit of the different options of glaucoma treatment, the economic burden of the disease and health insurance coverage for glaucoma patients.

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Paper 2: Risk factors for open-angle glaucoma in Nigeria.

Results from the Nigeria National Blindness and Visual Impairment Survey

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RESEARCH PAPER COVER SHEET

PLEASE NOTE THAT A COVER SHEET MUST BE COMPLETED FOR EACH RESEARCH PAPER INCLUDED IN A THESIS.

SECTION A – Student Details

Student	Mohammed M Abdull
Principal Supervisor	Clare Gilbert
Thesis Title	Adapted motivational interviewing to improve uptake of treatment in glaucoma patients in Bauchi state, Nigeria

If the Research Paper has previously been published please complete Section B, if not please move to Section C

SECTION B – Paper already published

Where was the work published?	BMC Ophthalmology		
When was the work published?	June 2016		
If the work was published prior to registration for your research degree, give a brief rationale for its inclusion	N/A		
Have you retained the copyright for the work?*	Yes, see appendix 5b	Was the work subject to academic peer review?	Yes

**If yes, please attach evidence of retention. If no, or if the work is being included in its published format, please attach evidence of permission from the copyright holder (publisher or other author) to include this work.*

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RESEARCH ARTICLE

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Risk factors for open-angle glaucoma in Nigeria: results from the Nigeria National Blindness and Visual Impairment Survey

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Abstract

Background: The glaucoma-specific blindness prevalence in Nigeria (0.7 %, 95 % CI 0.6–0.9 %) among those aged ≥ 40 years is one of the highest ever reported. This study determined the risk factors for open-angle glaucoma (OAG) in adults examined in the Nigeria National Blindness and Visual Impairment Survey.

Methods: A nationally representative sample of 13,591 people aged ≥ 40 years in 305 clusters in Nigeria were examined (response rate 90.4 %) between January 2005 to June 2007. Everyone had logMAR visual acuity measurement, Frequency Doubling Technology (FDT) visual field testing, autorefractometry, A-scan biometry and optic disc assessment. Full ocular examination ($n = 6397$), included Goldmann applanation tonometry. Values for defining glaucoma using International Society of Geographical and Epidemiological Ophthalmology criteria were derived from the study population. Disc images were graded by Moorfields Eye Hospital Reading Centre. Socio-demographic factors (age, gender, ethnicity, literacy and place of residence), ocular parameters (intraocular pressure [IOP], axial length and mean ocular perfusion pressure [MOPP]) and systemic parameters (blood pressure, blood glucose and body mass index [BMI]) were assessed for association with OAG.

Results: Thirteen thousand eighty-one (96 %) of 13,591 participants had vertical cup:disc ratio measured in at least one eye. 682 eyes of 462 participants were classified as OAG, with 12,738 controls. In univariate analyses the following were associated with OAG: increasing age, male gender, Igbo and Yoruba ethnic groups, illiteracy, longer axial length, higher IOP, lower MOPP, greater severity of hypertension and low BMI (underweight). In multivariate analysis, increasing age (odds ratio [OR] 1.04, 95 % CI 1.03–1.05), higher IOP (OR 1.22, 95 % CI 1.18–1.25) and Igbo ethnicity (OR 1.73, 95 % CI 1.18–2.56) were independent risk factors for OAG.

Conclusion: Case detection strategies for OAG should be improved for those aged ≥ 40 years and for ethnic groups most at risk as a public health intervention.

Keywords: Open-angle glaucoma, Risk factors, Ethnicity, Nigeria

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Background

In 2013 it was estimated that there were 64.3 million people aged 40–80 years with glaucoma worldwide, projected to increase to 76.0 million by the year 2020 and 111.8 million in 2040 [1]. Open-angle glaucoma (OAG) is the most prevalent type of glaucoma in Africa [1–6] and a leading cause of blindness and visual impairment [2, 7]. The glaucoma-specific blindness prevalence in Nigeria (0.7 %, 95 % confidence interval [CI] 0.6–0.9 %) among those aged 40 years and above is one of the highest ever reported [8], and glaucoma is the second-leading cause of blindness after cataract [8]. The all glaucoma prevalence in Nigeria in this age-group was 5.02 % (95 % CI 4.60–5.47 %), with 86 % being OAG based on gonioscopy. An estimated 1.2 million adults in Nigeria had glaucoma in 2012 [9].

There are some similarities in the epidemiology of OAG in sub-Saharan African and Caribbean populations. An interesting aspect of the Barbadian history is that a significant portion of the population was derived from the Bight of Biafra (also known as Bight of Bonny) in southeastern Nigeria; and about 44 % of enslaved Africans taken to Barbados during the 18th century were said to be mainly of Igbo origin [10]. Studies of risk factors for OAG in sub-Saharan Africa and African-derived black populations have reported that increasing age [3–6, 11–13] and higher intra-ocular pressures (IOP) [3, 4, 12, 14] are consistent and important risk factors. Although not always observed, men have a higher prevalence of glaucoma [4, 5, 12, 15]. A consistent finding is a higher prevalence of OAG in blacks compared to whites in populations where the two racial groups were studied [11, 13, 15]. The prevalence of glaucoma was higher in those with darker skin and of African birth [13], which suggest possible influence of environmental factors and inter-ethnic variation in the prevalence and risk of OAG within black populations, mediated by genetic factors. A higher prevalence of OAG in the urban population of Chennai compared to the rural population suggest a possible influence of lifestyle differences and non-communicable diseases such as hypertension and diabetes which are also more prevalent in the urban population [16]. Very few studies have explored other socio-demographic and systemic risk factors.

The Nigeria National Blindness and Visual Impairment Survey (hereafter referred to as the Nigeria Blindness Survey) is one of the largest population-based survey ever undertaken in Africa [17]. The present paper analysed data from the Nigeria Blindness Survey to explore risk factors for OAG among adults aged ≥40 years. Factors other than age and IOP were assessed. Identifying population groups most at risk, such as ethnic groups, will aid in planning appropriate control strategies and enhance the development of care-pathways to

prevent visual loss from glaucoma. It is envisaged that these results will also be relevant to other countries in sub-Saharan Africa and for African-derived black populations.

Methods

Details of all the methods used in the Nigeria Blindness Survey have been published [17] as well as data on the prevalence [7] and causes of visual impairment and blindness [8] and the prevalence and types of glaucoma in Nigeria [9].

Study design

The sample size calculation and sampling strategy for the Nigeria Blindness Survey gave a nationally representative sample of 15,375 persons aged 40 years and above in 310 clusters across the country. The sample size was also adequate for precise estimates of glaucoma prevalence and was adequately powered for risk factor analysis for OAG.

Multi-stage sampling using probability proportional to size methods was used to select the study population. Clinical data were collected by two teams, each comprising two ophthalmologists, one optometrist and two ophthalmic nurses.

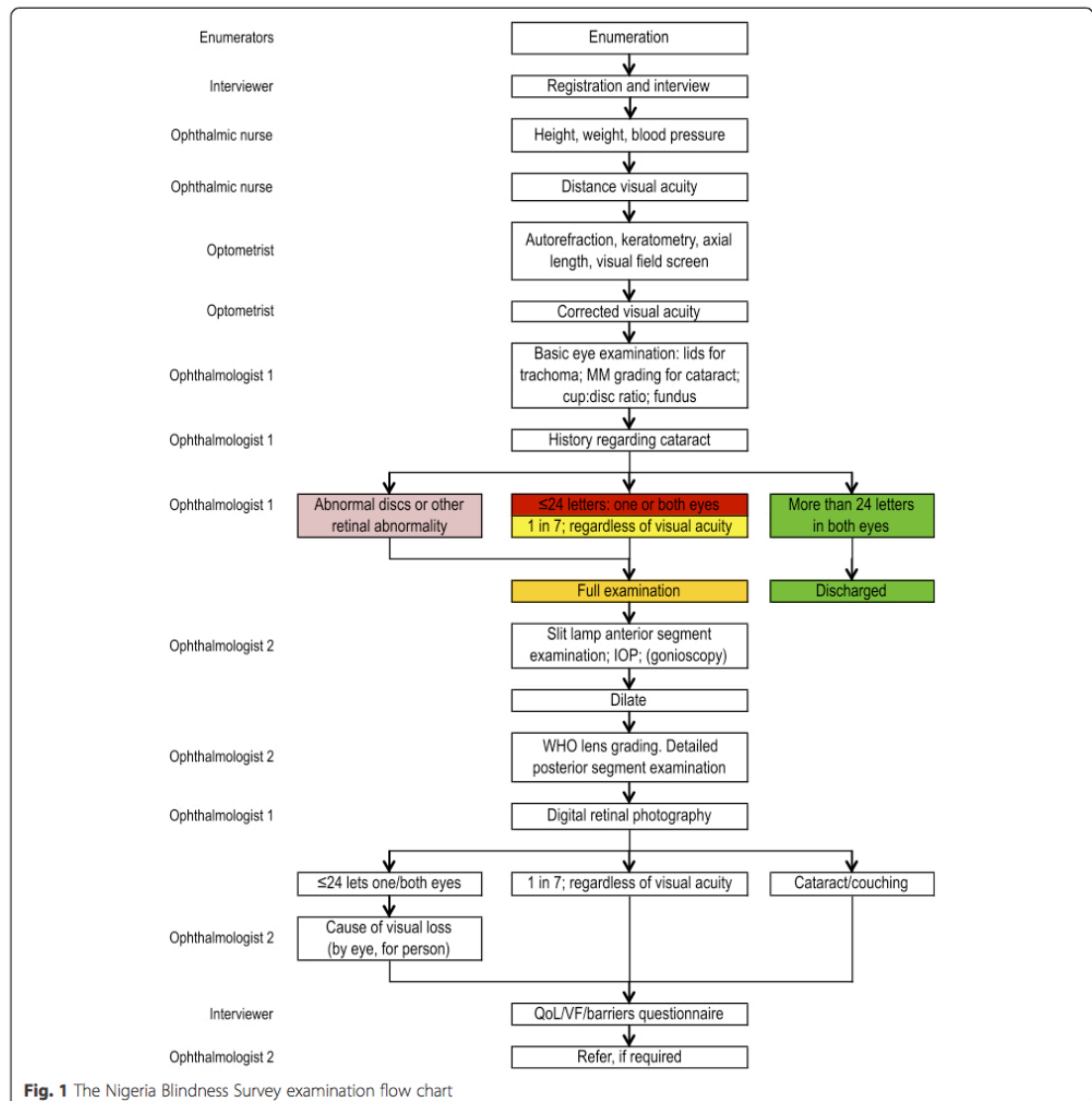
Data collection

All participants were invited to a temporary clinic for examination. Relevant personal and demographic details and examination findings were recorded.

The examination flow chart (Fig. 1; adapted [17]) indicates the data collected by the team members. All participants had presenting and best-corrected visual acuity (VA) measured with a reduced logMAR tumbling E-chart, automated refraction and keratometry (Takagi ARKM-100, Takagi Seiko, Japan), frequency doubling technology (FDT) visual function testing (Carl Zeiss Meditec AG Jena Germany) and ultrasound A-scan biometry (Bioline Biometer OPTIKON 2000 S.p.A Roma, Italy). All participants had basic eye examination performed by the first ophthalmologist, and detailed ocular examination was performed by the second ophthalmologist: in those with VA of worse than 20/40 in one or both eyes; vertical cup:disc ratio (VCDR) ≥0.6 in one or both eyes or VCDR asymmetry of ≥0.2, or any retinal abnormality seen on undilated funduscopy [17]. In addition, a subsample of 1-in-7 participants who also had the detailed examination regardless of their VA had a random blood glucose (RBG) test (OneTouch Ultra blood glucose meter, LifeScan UK).

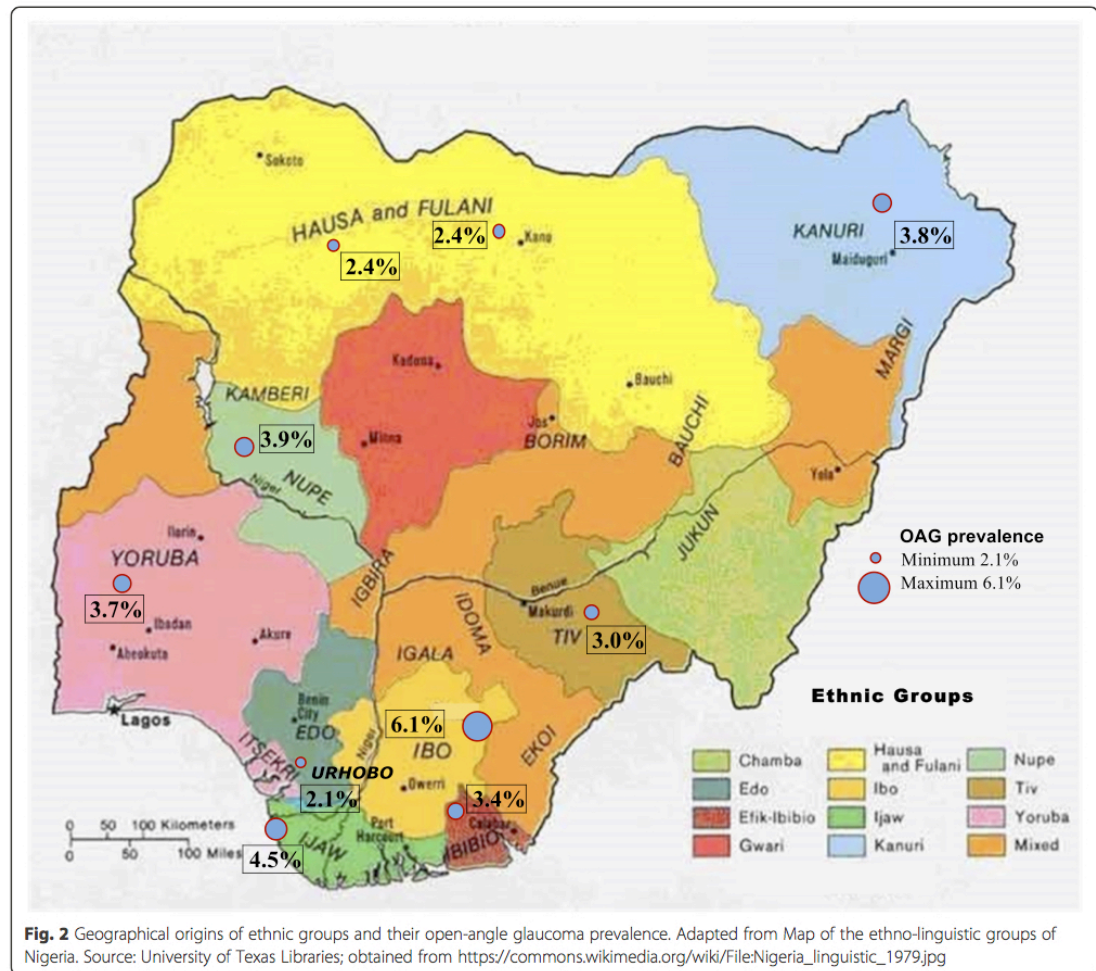
Risk factors assessment and classification

There were five socio-demographic 'person' factors (age, gender, ethnic group, literacy and place of residence), six



biophysical 'person' factors (presence of hypertension, severity of hypertension, systolic blood pressure [SBP], diastolic blood pressure [DBP], RBG and body mass index [BMI]); and three 'ocular' factors (axial length, IOP and mean ocular perfusion pressure [MOPP]). Age was analysed as a continuous variable and gender as a binary variable. Participants were asked about their ability to read and/or write and their ethnic group. Literacy was classified as ability to read and write or not at all and analysed as a binary variable. The geographical origins of some of the major ethnic groups

are shown in Fig. 2. The Ibibio and Ijaw are from the southern Niger delta region, the Igbos and Urhobos are from the southeastern equatorial region and the Hausa, Fulani and Kanuri are from the northern savannah region. Ethnic groups with ≥ 200 participants (Hausa, Yoruba, Igbo, Fulani, Kanuri, Tiv, Ijaw, Urhobo, Ibibio and Nupe) were categorised and analysed separately, and the smaller ethnic groups were combined into an 'others' category. Urban place of residence was defined as a settlement of more than 20,000 people.



Blood pressure (BP) was recorded three times with BP Omron wrist instrument (Omron Healthcare Ltd, Milton Keynes, England) after resting for at least 10 min [18]. Average values were used for analysis. Hypertension was defined as BP $\geq 140/90$ mmHg and severity was categorised using World Health Organization (WHO) categories: stage 1 for systolic/diastolic BP of $\geq 140/90$ mmHg, stage 2 $\geq 160/100$ mmHg and stage 3 $\geq 180/110$ mmHg [19]. SBP and DBP were analysed as continuous variables. RBG was grouped as less than 11.1 mmol/L or ≥ 11.1 mmol/L [20]. Height was measured to the nearest tenth of a centimeter and weight was measured to the nearest 100 g using standard equipment. BMI was calculated by dividing body weight (kg) by height (m) squared and categorised according to the international classification for adults i.e., underweight

(<18.5 kg/m²), normal (18.5–24.9 kg/m²), overweight (25.0–29.9 kg/m²) and obese (≥ 30.0 kg/m²) [21].

Axial length was measured by contact ultrasound A-scan biometry. IOP was measured using one Goldmann applanation tonometer in each of the two teams by the second ophthalmologist, using standard methods. To explore the association of vascular perfusion and OAG, the MOPP was calculated as $\frac{2}{3}[\text{DBP} + \frac{1}{3}(\text{SBP}-\text{DBP})-\text{IOP}]$ [22]. Axial length, IOP and MOPP were analysed as continuous variables.

A person was classified as having glaucoma if one or both eyes had glaucoma. The diagnosis of glaucoma was based on the International Society for Geographical and Epidemiological Ophthalmology (ISGEO) criteria with defining values obtained from a subsample of this study population [23]: VCDR ≥ 0.7 or VCDR asymmetry ≥ 0.1

(97.5th percentile) with evidence of glaucomatous visual function deficit; or VCDR ≥ 0.75 or VCDR asymmetry ≥ 0.2 (99.5th percentile) when visual fields results were not available; or IOP ≥ 28 mmHg (99.5th percentile) \pm VA worse than 20/400 or known glaucoma on treatment; or if there was relative afferent pupillary defect (RAPD) associated with high IOP and/or corneal edema. The Van Herick's anterior chamber (AC) angle estimation was performed on the slit-lamp with a narrow slit of light projected on the peripheral cornea, and was based on the relationship between the corneal slit image on the corneal surface and the AC depth. Grades 3 and 4 infer open angles and angle-closure is unlikely. The validity of the Van Herick's method for the estimation of the AC angle to correctly identify grades 3–4 as being open angles was assessed in comparison to identification of open angles by gonioscopy. Eyes with glaucoma were classified as OAG based on open-angles seen on gonioscopy or Van Herick's grades 3–4 in those who did not have gonioscopy.

Data for all participants classified as OAG were compared to those of the control group in analysis. Socio-demographic, ocular and biophysical factors were analysed for associations with OAG. The control group consisted of all other participants without OAG after excluding glaucoma eyes that did not have gonioscopy or Van Herick's test findings and those with other types of glaucoma, and phthisical eyes. The algorithm for selection of OAG cases and the control group is shown in Fig. 1.

Statistical analysis was performed using Stata/IC 13.0 (Stata Corp, College Station, TX).

We examined the association between OAG and each risk factor separately and report odds ratios with 95 % confidence intervals (CI). We used logistic regression to assess the independent effect of each risk factor on OAG and report adjusted odds ratios and 95 % CI intervals. BMI was also adjusted for gender. The following variables were included in the multivariable model: age, gender, ethnic group, literacy, rural/urban residence, BP, BMI, ocular axial length, IOP and MOPP. For ocular factors, the analysis took account of within-person correlation using robust standard errors. Possible extra variation introduced by the cluster sampling strategy was also considered but it did not impact the results.

Results

A summary of completeness of data for the Nigeria Blindness Survey has been reported: for participants undergoing full examination (6397), 88 % had IOP measurement with Goldmann applanation tonometer in at least one eye [9]. In the Nigeria Blindness Survey, 950/27,182 (3.50 %) eyes of 682/13,591 (5.02 %) participants had glaucoma according to the ISGEO criteria, of which 320 eyes of 208 persons were classified as OAG by

gonioscopy. 375 eyes had Van Herick's AC angle estimation but did not undergo gonioscopy. In eyes with both values, Grades 3 and 4 Van Herick's AC angle estimation had a 99.1 % sensitivity and 93 % positive predictive value in identifying open angles by gonioscopy. Thus, an additional 362 eyes of 254 persons were included as OAG cases as they had grades 3 or 4 Van Herick's estimation. Hence, 462 persons (682 eyes with OAG) were included in the analysis as OAG while 12,738 persons were classified as controls (without OAG) and 391 participants were excluded (Fig. 3).

The OAG group was older and more likely to be male (Table 1). The mean age \pm standard deviation (SD) of participants with OAG was significantly higher than that of controls (66.2 ± 12.3 years Vs 55.4 ± 12.1 years, $p < 0.001$). Men with OAG were significantly older (mean age 67.6 years ± 12.7) than women with OAG (mean age 64.8 years ± 11.8 ; $p = 0.02$). The OAG group also had a higher proportion of participants that were of the Yoruba or Igbo ethnic group, illiterate and with hypertension and low BMI (underweight). After adjusting BMI for gender, the odds of OAG was higher in underweight women (OR 1.84, 95%CI 1.27–2.68; $p = 0.001$) but not after adjusting for age or for age and IOP. The mean \pm SD IOP was higher in eyes with OAG (22 ± 11 mmHg) than in eyes without OAG (14 ± 4 mmHg, $p < 0.001$). Similarly, the mean ocular axial length was longer in eyes with OAG (22.8 ± 1.09 mm) than in those without OAG (22.6 ± 0.97 mm, $p = 0.001$).

In univariate analysis, increasing age was positively associated with OAG (Odds ratio [OR] 1.06, 95 % CI 1.06–1.07; $p < 0.001$), as was being male (OR 1.29, 95 % CI 1.06–1.57; $p = 0.01$) (Table 2). There was 6 % higher odds of OAG with each increasing year of age. The following factors were also positively associated with OAG: Igbo and Yoruba ethnic groups, being illiterate, any hypertension and greater severity of hypertension, low BMI (underweight), longer ocular axial length, higher IOP and lower MOPP (Table 2). When adjusted for myopia, axial length remained significantly associated with OAG (OR 1.13, 95 % CI 1.02–1.25; $p = 0.03$). In multivariate logistic regression analyses, increasing age, higher IOP and Igbo ethnic group were identified as independent risk factors for OAG. The ethnic group-specific prevalence of OAG for the analysed ethnic groups are shown in Fig. 2. The Urhobo had the lowest odds of OAG (OR 0.69, 95 % CI 0.24–1.97), while the Kanuri (OR 1.81, 95 % CI 0.90–3.63; $p = 0.10$) and Igbo (OR 1.73, 95 % CI 1.18–2.56; $p = 0.01$), the highest. The Igbo ethnic group had a 73 % higher odds of OAG than the Hausa (reference group) (Table 2); and when adjusted for gender, Igbo men were 2.5 times more likely to have OAG than Hausa men (OR 2.54, 95 % CI 1.50–4.30; $p = 0.001$).

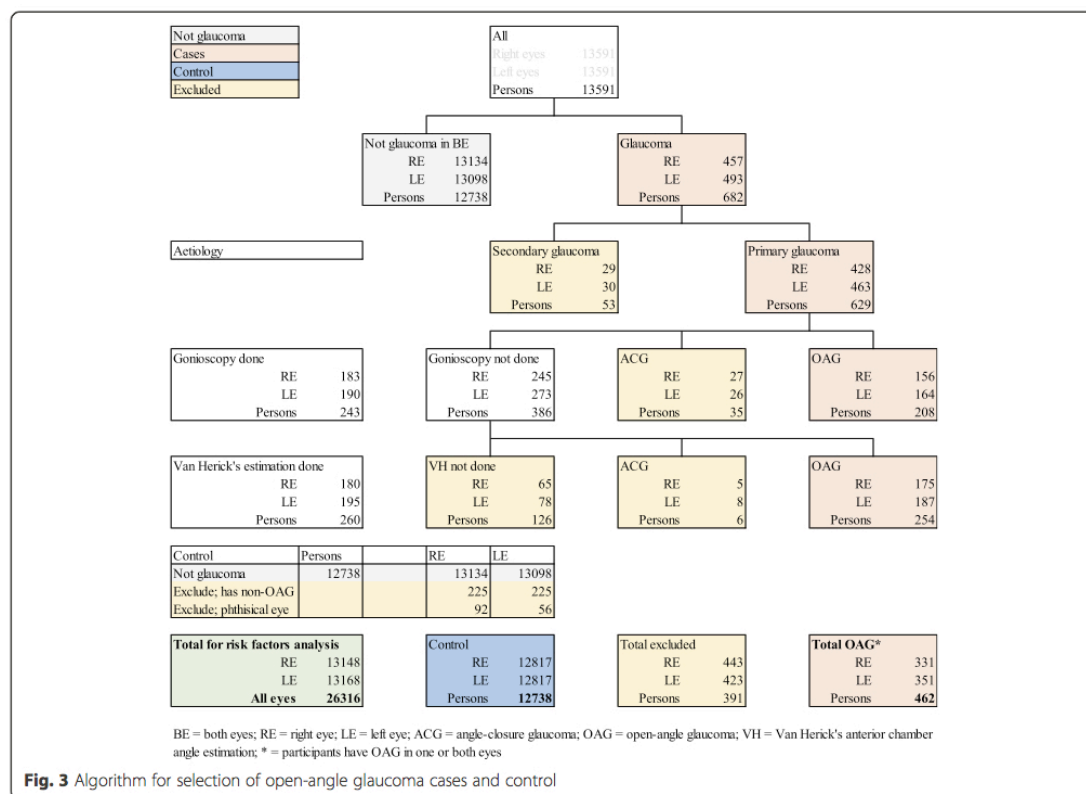


Fig. 3 Algorithm for selection of open-angle glaucoma cases and control

Systemic hypertension (BP $\geq 140/90$ mmHg) was also associated with OAG, with moderate and severe hypertension having stronger and significant association with OAG in univariate analysis. After adjusting for age, IOP and other potential risk factors in a multivariable model, mildly elevated BP (stage 1) was protective of OAG compared to participants without hypertension but this was not statistically significant (OR 0.87, $p = 0.52$). There was a strong association between lower MOPP and OAG ($p < 0.001$) in univariate analysis which did not persist after adjusting for age, IOP and other factors.

In univariate analysis, lower BMI was associated with 60 % greater odds of OAG ($p = 0.001$) and the odds decreased with increasing BMI. However, in the adjusted model, BMI was not statistically significant.

Discussion

We report results of the first cross-sectional study of risk factors for OAG in sub-Saharan Africa in a large population-based, nationally representative survey in Nigeria. We did not explore the risk factors for angle-closure glaucoma, as the numbers were too few. Older

age and higher IOP were independent risk factors for OAG. Additionally, an important and new finding was that the Igbo ethnicity was an independent risk factor associated with OAG, especially in men.

Significant inter-racial variation between White, Asian and Black populations has been described [11, 13, 15, 24] with the prevalence and risks of OAG being higher in Blacks. However, studies in smaller population groups in sub-Saharan Africa have not identified differences in risks of OAG by ethnic group within black populations [5, 25]. Under-powered sample sizes may be a reason why they could not detect ethnic differences in those studies. The Nigeria Blindness Survey had relatively large numbers of the main ethnic groups, giving adequate power to detect significant associations and differences within the black population. One of the potential reasons for the ethnic differences we observed may be the differential susceptibility due to larger optic discs. As reported in the normative data for the classification of glaucoma in prevalence surveys in Nigeria, the 97.5th percentile VCDR for the Igbo was 0.7 compared to 0.6 for the Fulani. Interestingly, the 99.5th percentile for IOP was

Table 1 Distribution of participants with and without open-angle glaucoma by socio-demographic, biophysical and ocular characteristics

	Without OAG [control]		OAG [cases]	
	<i>n</i> = 12,738 (96.5 %)		<i>n</i> = 462 (3.5 %)	
	<i>n</i>	%	<i>n</i>	%
Socio-demographic factors				
Age group (years)				
40 – 49	4760	37.4	45	9.7
50 – 59	3415	26.8	75	16.2
60 – 69	2550	20.0	124	26.9
70 – 79	1439	11.3	141	30.5
80+	574	4.5	77	16.7
Age (years) Mean ± SD	55.4 ± 12.1		66.2 ± 12.3	
				<i>p</i> < 0.001
Gender				
Female	6940	54.5	221	47.8
Male	5798	45.5	241	52.2
Ethnic group ^a				
Hausa	3191	25.2	78	16.9
Yoruba	2478	19.5	95	20.6
Igbo	1752	13.8	114	24.7
Fulani	801	6.3	20	4.3
Kanuri	326	2.6	13	2.8
Tiv	328	2.6	10	2.2
Ijaw	234	1.8	11	2.4
Urhobo	231	1.8	5	1.1
Ibibio	199	1.6	7	1.5
Nupe	198	1.6	8	1.8
Others	2946	23.2	100	21.7
Literacy				
Literate	5618	44.1	159	34.4
Illiterate	7120	55.9	303	65.6
Place of residence				
Rural	9883	77.6	354	76.6
Urban	2855	22.4	108	23.4
Biophysical factors				
Blood pressure (mmHg) ^a				
Normal	9343	73.8	308	67.2
Hypertension ≥140/90 mmHg	3315	26.2	150	32.8
Random blood glucose (mmol/L) ^a				
Normal	1551	97.1	98	96.1
Diabetes ≥11.1 mmol/L	47	2.9	4	3.9
Body mass index ^a				
Normal 18.5–24.9 kg/m ²	7672	61.1	276	60.6
Underweight <18.5 kg/m ²	1365	10.9	74	16.3
Overweight 25.0–29.9 kg/m ²	2464	19.6	75	16.5
Obese ≥30.0 kg/m ²	1060	8.4	30	6.6

Table 1 Distribution of participants with and without open-angle glaucoma by socio-demographic, biophysical and ocular characteristics (*Continued*)

Ocular factors ^b			
Total eyes N = 26,316 (100 %)	25,634 (97.4 %)	682 (2.6 %)	
Axial length (mm) Mean ± SD	22.63 ± 0.97	22.76 ± 1.09	<i>p</i> = 0.001
IOP (mmHg) Mean ± SD	14 ± 4	22 ± 11	<i>p</i> < 0.001

IOP intraocular pressure, OAG open-angle glaucoma, SD standard deviation

^amissing values excluded; ^bocular factors distribution by eyes

lower for the Igbo (22 mmHg) than for the Hausa (28 mmHg) [23] and this may imply that the Igbos have thinner corneas. However, a major limitation in interpreting this difference is the absence of pachymetry to measure central corneal thickness in the Nigeria Blindness Survey, which would have enabled corrected IOP estimates for comparison. Optic disc parameters are important in OAG with respect to attenuation of structural support, axonal protection and metabolic support provided by astrocytes [26]. These quantitative parameters are heritable traits [27, 28], thus genetic variation is another plausible reason for the ethnic differential risk. Genome-wide association studies (GWAS) in the African Caribbean population of Barbados, which has a high prevalence of OAG (6.8 %, 95 % CI 6.1–7.7 % in Blacks ≥40 years old) [15], confirmed two mechanisms of gene interaction with OAG: the absence of protective genes, and the presence of predisposing alleles increased the risk for OAG [29, 30]. Although the demographics of Barbados have been dynamic, and there are other socio-demographic and lifestyle factors that influence disease incidence [31] and progression [12, 32], the historical link between the Igbos and Barbadians lends credence to the genetic basis for the ethnic differences in risk of OAG seen in Nigeria.

Another interesting observation in our study was the strong association between low BMI (underweight) and OAG, albeit only in univariate analysis: presumably because of age, as older persons have lower BMI especially when of poor socioeconomic status. Higher BMI has been reported to be protective for OAG in Barbados [12] and Rotterdam [33]. Systemic inflammatory process [34] are possible linking factors which may also result in weight loss from general debilitation.

Our study did not find significant difference in risk for OAG in urban compared to rural population as seen in urban South India where the prevalence of OAG was more than doubled than in the rural population [16]; and possible associations with hypertension or diabetes were not statistically significant.

All studies have shown increasing age to be a risk factor for OAG [12, 31, 32, 35–43]. Indeed, in the Barbados

Eye Study a 4 % increase in the relative risk of OAG per year was reported [31], and comparable to 6 % higher odds of OAG per year in this study. Increasing mitochondrial dysfunction in retinal ganglion cells and increased vulnerability of the optic nerve to neurodegeneration from oxidative stress serve as possible links between ageing and increased risk for OAG [44, 45].

This study also demonstrated that higher IOP has an independent association with OAG, as in numerous other studies. Higher IOP was an independent risk factor for glaucoma despite a large number of eyes having IOPs lower than the 'upper limit of normal' i.e. mean (+2SD) [40]. In the National Blindness Survey, 56 % of glaucoma eyes had IOP <22 mmHg; the mean IOP in glaucoma eyes was 23 (SD12) mmHg and the mean IOP in non-glaucoma eyes was 14 (SD4) mmHg [9]. This underscores the role of IOP as a tool for monitoring response to treatment rather than as a diagnostic factor.

Men had higher odds of OAG but only in univariate analysis. An increased risk of OAG in men has been reported in previous prevalence studies in Barbados, United States [12, 32] and Singapore [43], and in a Bayesian meta-analysis, men were more likely to have POAG than women (OR 1.36, 95 % CI 1.23–1.52) [1]. Further incidence studies are needed to clarify gender differences in risks of OAG.

Some studies have addressed associations between ocular perfusion factors (IOP, BP and MOPP) and OAG which suggest that vascular insufficiency is an important factor in OAG [31, 38, 46], as was in our study, higher BP and lower MOPP were significantly associated with higher odds of OAG.

Longer ocular axial length has been associated with OAG [37, 47]. In the Nigeria Blindness Survey axial length was longer in OAG eyes and was significantly associated with OAG, but this was not an independent risk factor after adjusting for age, IOP and other variables. In our study we assessed axial length rather than myopia as a potential risk factor because there was a high prevalence of nuclear lens opacities (8.8 %, 95 % CI 7.5–10.1) [48] which would increase

Table 2 Open-angle glaucoma and association with potential risk factors

	All eyes	OAG	Univariate analysis			Multivariate analysis		
	<i>n</i> (%)	<i>n</i> (%)	OR	95 % CI	<i>p</i> -value	OR	95 % CI	<i>p</i> -value
	26,316 (100 %)	682 (2.6 %)						
Socio-demographic factors								
Age (years)	(Min 40)		Reference			Reference		
Increasing age	(Max 100)		1.06	1.06–1.07	<0.001	1.04	1.03–1.05	<0.001
Gender	Female	328 (2.3)	Reference			Reference		
	Male	354 (2.9)	1.29	1.06–1.57	0.01	1.23	0.94–1.61	0.13
Ethnic group	Hausa	113 (1.7)	Reference			Reference		
	Yoruba	150 (2.9)	1.71	1.24–2.36	0.001	1.10	0.75–1.63	0.62
	Igbo	167 (4.5)	2.70	1.98–3.68	<0.001	1.73	1.18–2.56	0.01
	Fulani	31 (1.9)	1.09	0.65–1.85	0.73	1.18	0.65–2.19	0.58
	Kanuri	20 (2.9)	1.72	0.92–3.23	0.09	1.81	0.90–3.63	0.10
	Tiv	15 (2.2)	1.30	0.64–2.62	0.47	1.03	0.42–2.52	0.96
	Ijaw	14 (2.9)	1.69	0.86–3.35	0.13	1.51	0.50–4.60	0.47
	Urhobo	7 (1.5)	0.85	0.32–2.23	0.74	0.69	0.24–1.97	0.48
	Ibibio	10 (2.4)	1.43	0.62–3.27	0.40	1.29	0.58–2.89	0.53
	Nupe	9 (2.2)	1.29	0.59–2.79	0.52	1.25	0.58–2.67	0.57
	Others	144 (2.4)	1.38	1.01–1.90	0.05	1.13	0.75–1.70	0.57
Literacy	Literate	235 (2.0)	Reference			Reference		
	Illiterate	447 (3.0)	1.50	1.22–1.84	<0.001	1.06	0.79–1.42	0.70
Place of residence	Rural	527 (2.6)	Reference			Reference		
	Urban	155 (2.6)	1.02	0.81–1.28	0.88	1.14	0.85–1.54	0.38
Biophysical factors								
Hypertension	Normal	454 (2.4)	Reference			NI		
	Hypertension	223 (3.2)	1.38	1.12–1.70	0.002			
Blood pressure	Normal	454 (2.4)	Reference			Reference		
(severity of	stage 1 mild	110 (2.7)	1.15	0.88–1.51	0.31	0.87	0.57–1.33	0.52
hypertension)	stage 2 moderate	68 (3.7)	1.61	1.16–2.24	0.01	1.05	0.58–1.90	0.87
	stage 3 severe	45 (4.4)	1.91	1.27–2.88	0.002	1.05	0.45–2.45	0.90
Systolic BP	(Min 60)		Reference			NI		
	(Max 259)		1.01	1.01–1.02	<0.001			
Diastolic BP	(Min 35)		Reference			NI		
	(Max 157)		1.01	1.00–1.02	0.002			
RBG ^a	Normal	141 (4.3)	Reference			NI		
	Diabetes	4 (4.1)	0.94	0.33–2.67	0.91			
Body mass index	Normal	406 (2.6)	Reference			Reference		
(Categories)	Underweight	116 (4.0)	1.60	1.21–2.10	0.001	1.29	0.91–1.83	0.16
	Overweight	111 (2.2)	0.85	0.65–1.12	0.26	0.82	0.58–1.17	0.27
	Obese	42 (1.9)	0.75	0.50–1.12	0.16	1.18	0.71–1.96	0.52
Ocular factors								
Axial length (mm)	(Min 18.4)		Reference			Reference		
	(Max 30.0)		1.14	1.03–1.26	0.01	0.99	0.89–1.10	0.88
IOP (mmHg)	(Min 5)		Reference			Reference		
	(Max 50)		1.21	1.18–1.23	<0.001	1.22	1.18–1.25	<0.001

Table 2 Open-angle glaucoma and association with potential risk factors (*Continued*)

MOPP (mmHg)	(Min 6)	Reference	Reference	Reference	Reference	Reference
	(Max 115)	0.96	0.95–0.97	<0.001	1.01	0.99–1.03
						0.40

BP blood pressure, IOP intraocular pressure, MOPP mean ocular perfusion pressure, NI not included in multivariable models, OAG open-angle glaucoma,

RBG random blood glucose

^atested for 1641 persons only

the risk of index myopia; and a relatively low prevalence of myopia $\leq 0.5D$ (after excluding persons with lens opacity, 9.4 %, 95 % CI 8.7–10.2) [49].

A strength of the Nigeria Blindness Survey is that it was nationally representative and had a large sample size with adequate power to detect statistical associations. A range of ethnic groups was represented in large enough numbers to allow comparison of risk between the largest ethnic groups in Nigeria. As part of the study protocol, not all participants had gonioscopy done and we did not record the presence of pseudoexfoliation (PXE). Hence, PXE was not assessed as a risk factor for OAG. In addition, some eligible participants did not have gonioscopy performed due to damage to the mirrors on the gonioscopy lenses by high humidity; and did not have Van Herick's AC angle estimation due to structural ocular pathology. Another limitation was that IOP was measured once and it was not interpreted using central corneal thickness, which was not measured. Additionally, visual field analysis was by FDT and participants classified as glaucoma did not undergo Humphrey visual field analysis (HFA). We were also not able to obtain information on duration of hypertension, history of cardiovascular disease or use of antihypertensive medication. However, this may not have a significant impact as only 14 % of participants reported being hypertensive [18]. Additionally, we did not obtain information on family history of glaucoma which would not have been reliable in this context. Indeed, only 5.6 % of those identified with OAG knew they had the condition [9].

This is the first time that an association of OAG has been observed with some ethnic groups. It is imperative that this finding be replicated in further studies as it may be a chance finding. While cultural or other practices might underlie the differences, or failure to fully adjust for confounders, given the relative lack of environmental factors identified to date for OAG, these observations suggest the need for a molecular genetics study of glaucoma in Nigeria. This might be included within a follow-up study on the cohort of the Nigeria Blindness Survey to explore the natural history and incidence of glaucoma, and the influence of immunological markers of inflammation.

Conclusion

This study gives us risk factors data on OAG and confirms that OAG is a public health problem in people ≥ 40 years. As a public health strategy, opportunistic eye examination, case detection and examination for OAG need to be performed on all people aged ≥ 40 years and the ethnic groups most at risk.

Abbreviations

AC, Anterior chamber; BMI, Body mass index; BP, Blood pressure; CI, Confidence intervals; DBP, Diastolic blood pressure; FDT, Frequency doubling technology; GWAS, Genome-wide association studies; IOP, Intraocular pressure; ISGEO, International Society of Geographical and Epidemiological Ophthalmology; MOPP, Mean ocular perfusion pressure; OAG, Open-angle glaucoma; OR, Odds ratio; RAPD, Relative afferent pupillary defect; RBG, Random blood sugar; SBP, Systolic blood pressure; SD, Standard deviation; VA, Visual acuity; VCDR, Vertical cup:disc ratio; WHO, World Health Organization.

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Availability of data and materials

Data are currently with the authors as the study is on-going. It will be deposited with the Director, Health Planning, Research and Statistics, Federal Ministry of Health, Abuja, Nigeria.

Authors' contributions

FK and CG developed the study concept and design. FK, MA, RW, JE, WN, GVSM and CG were involved in acquisition, analysis, or interpretation of data. The manuscript was drafted by FK and edited by RW and CG. FK, AM, RW, JE, WN, GVSM and CG critically revised the manuscript for important intellectual content. Statistical analysis was done by FK and JE. FK and CG obtained funding. The study was supervised by FK, RW, WN, GVSM and CG. All authors have read and approved of the final version of the manuscript.

Competing interests

The authors declare that they have no competing interests.

Consent for publication

Not applicable.

Ethics approval and consent to participate

Ethical approval was obtained from the Ethics Committee of the London School of Hygiene & Tropical Medicine and the Federal Ministry of Health of Nigeria. Oral informed consent was obtained from community leaders, heads of households and all participants. The study adhered to the tenets of the declaration of Helsinki. Participants with treatable ocular conditions were referred and cataract blind participants were offered surgery.

Previous presentation

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Paper 3: Posterior segment eye disease in sub-Saharan Africa: review of recent population-based studies

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SECTION A – Student Details

Student	Mohammed M Abdull
Principal Supervisor	Clare Gilbert
Thesis Title	Adapted motivational interviewing to improve uptake of treatment in glaucoma patients in Bauchi state, Nigeria

If the Research Paper has previously been published please complete Section B, if not please move to Section C

SECTION B – Paper already published

Where was the work published?	Trop Med Int Health		
When was the work published?	February 2014		
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For multi-authored work, give full details of your role in the research included in the paper and in the preparation of the paper. (Attach a further sheet if necessary)	Participated in the literature review, especially all the data on glaucoma and participated in other analysis and write up of the paper
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Student Signature: _____

Date: 15 December 2016

Supervisor Signature: _____

Date: 15 December 2016

Posterior segment eye disease in sub-Saharan Africa: review of recent population-based studies

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Abstract

OBJECTIVE To assess the burden of posterior segment eye diseases (PSEDs) in sub-Saharan Africa (SSA).

METHODS We reviewed published population-based data from SSA and other relevant populations on the leading PSED, specifically glaucoma, diabetic retinopathy and age-related macular degeneration, as causes of blindness and visual impairment in adults. Data were extracted from population-based studies conducted in SSA and elsewhere where relevant.

RESULTS PSEDs, when grouped or as individual diseases, are a major contributor to blindness and visual impairment in SSA. PSED, grouped together, was usually the second leading cause of blindness after cataract, ranging as a proportion of blindness from 13 to 37%.

CONCLUSIONS PSEDs are likely to grow in importance as causes of visual impairment and blindness in SSA in the coming years as populations grow, age and become more urban in lifestyle. African-based cohort studies are required to help estimate present and future needs and plan services to prevent avoidable blindness.

keywords glaucoma, diabetic retinopathy, age-related macular degeneration, posterior segment eye disease, prevalence, incidence, blindness, visual impairment, Africa

Introduction

Non-communicable diseases in low- and middle-income countries

In recent decades, there has been a marked rise in life expectancy that has contributed to a major epidemiological shift in populations worldwide (Lopez *et al.* 2006). These changes will increasingly lead to major public health issues in low- and middle-income countries (LMIC; Mathers & Loncar 2006). Current projections suggest that non-communicable diseases (NCDs) will contribute to two-thirds of global mortality by the year 2030 (Mathers & Loncar 2006). NCDs in LMIC have shown substantial variation in prevalence, incidence, natural history and risk factors compared with NCDs in populations in high-income countries (Boutayeb 2006).

Visual impairment and blindness

285 million people are visually impaired (VI) worldwide, (severe visual impairment (SVI) defined as presenting

visual acuity (PVA) <6/60 but ≥3/60, moderate VI defined as PVA <6/18 but ≥6/60) of whom 39 million are blind (presenting visual acuity <3/60 in the better eye; Pascolini & Mariotti 2012). Approximately 90% of those worldwide with VI live in low-income countries. NCDs are the leading causes of VI, in part due to the successful control of infectious diseases. VI is ranked sixth in the top ten causes of burden of disease in terms of disability-adjusted life-years (DALYs) in low-income, middle-income and high-income countries (Chiang *et al.* 2006). The sum of DALYs from VI is 66 290 000 (4.3% of total), just below HIV/AIDS at 71 460 000 (4.7%).

The number of people visually impaired in the World Health Organization (WHO) African region is estimated to be 26 million, of whom almost 6 million are blind. This is based on estimates from population-based studies in Botswana, Cameroon, Eritrea, Ethiopia, Gambia, Ghana, Kenya, Mali, Nigeria, Rwanda, Uganda and Tanzania (Pascolini & Mariotti 2012). Despite Africa having one of the highest prevalences of blindness, it is the most underserved continent in terms of human resources

available to treat and manage eye disease (Resnikoff *et al.* 2012), with the greatest gap between existing need and provision (Bastawrous & Hennig 2012).

In 2010, the WHO reported the leading causes of visual impairment (VI) and blindness (Pascolini & Mariotti 2012). Of these, three of the nine listed leading causes are NCDs which are posterior segment in location, (i.e. affecting the back of the eye). Posterior segment eye disease (PSED) epidemiologically is commonly defined as diseases of the retina, choroid and optic nerve and primarily includes: glaucoma, age-related macular degeneration (AMD) and diabetic retinopathy (DR). These three conditions are the focus of this paper but do not constitute all PSEDs. See Figure 1.

PSED and VISION2020

VISION2020 is the global initiative for the elimination of avoidable blindness, launched in 1999, jointly by WHO and the International Agency for the Prevention of Blindness (IAPB) and provides technical support and advocacy to prevention of blindness activities worldwide. It aims over two decades to prevent 100 million people from becoming blind.

VISION2020 has largely focused on the elimination of anterior segment diseases, primarily cataract, as it alone causes almost half of blindness and is amenable to cure through surgery. VISION2020 has not focused on PSED to date mostly due to a lack of data on the magnitude of these conditions and lack of cost-effective treatment options. This review aims to establish the magnitude of visual impairment and blindness in SSA that can be attributed to PSED.

Materials and methods

Our literature search was conducted for the years 1966 to September 2012 using PubMed. Keywords used included the following: posterior segment eye disease,

glaucoma, age-related macular degeneration, diabetic retinopathy, correctable visual impairment, preventable, avoidable, Africa (MeSH), aphakia, blindness, visual impairment, prevalence and population.

Studies were selected for inclusion if they were population based, performed in sub-Saharan Africa with a sample size >1000, reported visual acuity impairment with its causes, had a high participation rate (>80% of the targeted sample) and presented results using the standard WHO categories of VA. WHO definitions of visual impairment are used (WHO/ICD-10 2007). We also searched reference lists of studies meeting inclusion criteria. Only published data were included.

All-cause prevalence (and 95% confidence interval [CI]) of blindness, SVI and moderate VI was extracted from each study, as well as the proportion of blindness, SVI and moderate VI due to PSED (grouped or as single diseases when available); then, the prevalence of blindness, SVI and moderate VI due to PSED was calculated from these estimates.

Results

Search results

In total, the initial search criteria identified 112 potential manuscripts for inclusion. Review of the abstracts reduced this to 39 potential studies, of which 17 surveys, from 13 SSA countries, encompassing 88 067 individuals were included for analysis having fully met the pre-specified search criteria. Data from the following countries are presented: Burundi (Kandeke *et al.* 2012), Cameroon (Oye *et al.* 2006; Oye & Kuper 2007), Eritrea (Muller *et al.* 2011), Ethiopia (Berhane *et al.* 2007), Ghana (Budenz *et al.* 2012), Guinea (Moser *et al.* 2002), Kenya (Mathenge *et al.* 2007a, 2012), Malawi (Kalua *et al.* 2011), Nigeria (Adegbehingbe *et al.* 2006; Abdull *et al.* 2009), Rwanda (Mathenge *et al.* 2007b), South Sudan (Ngondi *et al.* 2006), Tanzania (Kikira

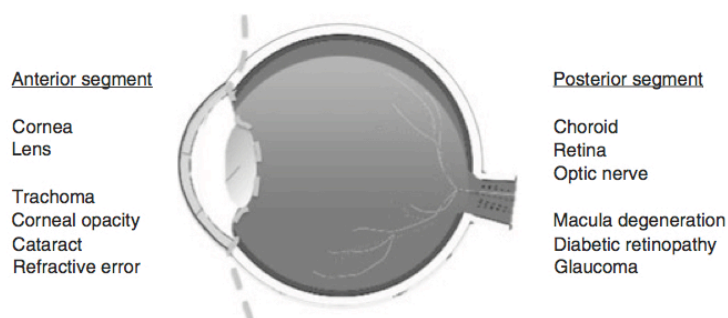


Figure 1 Cross-sectional diagram of the eye demonstrating the anterior and posterior segments and their potential diseases.

2007; Habiakire *et al.* 2010) and Uganda (Mbulaiteye *et al.* 2002).

Posterior segment eye disease

Although PSEDs are frequently collated in SSA-based epidemiological studies and presented as a single entity or group of conditions, they are clinically and pathophysiological distinct. The most common methodological approach deployed in SSA population-based studies, the rapid assessment of avoidable blindness (RAAB; Dineen *et al.* 2006), is not sufficiently sensitive to differentiate posterior segment causes of low vision and hence presented results are often collated.

Posterior segment eye disease in Africa

Cross-sectional population-based studies from the last two decades performed in Africa have shown PSED to be consistently the second (and occasionally the most common) leading cause of blindness. This includes studies from Kenya (Mathenge *et al.* 2007a, 2012), Nigeria (Rabiu & Muhammed 2008; Abdull *et al.* 2009), Tanzania (Kikira 2007; Habiakire *et al.* 2010), Rwanda (Mathenge *et al.* 2007b), Cameroon (Oye *et al.* 2006; Oye & Kuper 2007), Ghana (Guzek *et al.* 2005), Guinea (Moser *et al.* 2002), Burundi (Kandeke *et al.* 2012) and Ghana (Budenz *et al.* 2012; See Table 1). No longitudinal data on PSED from population-based studies in Africa have been published. A single cohort in Uganda has 3-year cumulative incidence data on visual impairment, (age-standardised incidence rate of 13.2, per 1000 PY) with AMD and glaucoma amongst the leading causes of visual loss in new cases (Mbulaiteye *et al.* 2003). However, no baseline clinical phenotyping data were collected in eyes initially without visual impairment, so early asymptomatic disease was not excluded.

The majority of available prevalence data in Africa come from the rapid assessment of avoidable blindness (RAAB) methodology (Dineen *et al.* 2006). Although RAAB is a validated survey method (Mathenge *et al.* 2012), it has a limitation in common with more comprehensive surveys such as the Nigeria study (Dineen *et al.* 2008) in that detailed eye examinations are only performed in those found to have impairment of their visual acuity. As glaucoma patients usually lose central vision at the end stage of the disease, they are frequently missed unless visual field assessment is performed. Furthermore, ophthalmic assessment in RAAB relies on direct ophthalmoscopy, constraining diagnostic accuracy, so that the diseases are pragmatically grouped together as one unit.

The majority of these surveys have used the WHO coding instructions, which use the 'principal disorder responsible for visual loss in the individual after considering disorders in either eye which are most amenable to treatment or prevention' (World Health Organization 1988). In other words, if a patient has PSED coexistent with cataract, it will be deemed that cataract is the primary cause of blindness/VI. Therefore, most VI prevalence data available in which cataract or refractive error is the primary cause will underestimate the prevalence of PSED at all levels of visual acuity.

Glaucoma in Africa

Prevalence. Current estimates suggest that there are 6.5 million people with glaucoma at all levels of vision in sub-Saharan Africa (SSA) with a projected increase to 8.4 million in 2020 (Quigley & Broman 2006). Glaucoma is estimated to be the second leading cause of blindness in Africa (Cook 2009). These estimates undertaken by Quigley and Broman (2006) are based on seven population-based studies, of which two examined individuals of African descent living outside of the African continent: in Baltimore, USA (Leske *et al.* 1994) and Barbados (Tielsch *et al.* 1991a) which has multiple limitations for inferring data. Of the five based in Africa, three were undertaken in South Africa (Salmon & Martell 1994; Rotchford & Johnson 2002; Rotchford *et al.* 2003), one in Ghana (Ntim-Amponsah *et al.* 2004) and one in Tanzania (Buhrmann *et al.* 2000). The studies used varying sampling methods and criteria for diagnosis of glaucoma.

No specific and sensitive test for glaucoma exists. Current reference standard diagnosis requires expensive visual field-testing equipment with expert interpretation of the optic disc and visual field findings. Standardised definitions and classifications of glaucoma in recent years have allowed for better prevalence estimates and comparisons between populations (Foster *et al.* 2002).

Glaucoma may be congenital or acquired and further subclassified into open-angle and closed-angle based on the mechanism by which aqueous outflow from the eye is compromised. The 'angle' refers to the junction between cornea and iris, which forms an angle of varying degree in each eye. Generally speaking, in glaucoma, when this angle is large and the structures within it are visible on clinical examination (gonioscopy), it is termed 'open-angle glaucoma' and when these structures are limited or not visible due to a narrow angle, it is termed 'closed- or narrow-angle glaucoma' (Kanski 2007). Primary open-angle glaucoma (POAG) disproportionately affects individuals of African descent (Quigley & Broman 2006) and is difficult to diagnose in early disease, and when

Table 1 Reviewed studies

Country	Level	Year published	Sample size (number examined)	Response rate (%)	Age (years)	Primary cause of blindness	Secondary cause of blindness	Equipment used for diagnosis	References
Burundi	Provincial	2012	3684	97	≥50	Cataract (55%)	PSED (37%)	Nor stated	Kandeke <i>et al.</i> (2012)
Cameroon	Limbe	2007	2215	92.3	≥40	Cataract (62%)	PSED (25%)	Direct ophthalmoscope	Oye and Kuper (2007)
Cameroon	Muyuka	2006	1787	89.3	≥40	PSED (29%)	Cataract (21%)	Direct ophthalmoscope	Oye <i>et al.</i> (2006)
Eritrea	National	2011	3163	95.9	≥50	Cataract (55%)	Glaucoma (15%)	Portable slit lamp	Muller <i>et al.</i> (2011)
Ethiopia	National	2007	25650	85.4	All	Cataract (50%)	Trachoma (8%)	Direct ophthalmoscope	Berhane <i>et al.</i> (2007)
Ghana	City	2012	5603	82.3	≥40	Cataract (44%)	Glaucoma (22%)	Slit lamp/fundus camera	Budenz <i>et al.</i> (2012)
Guinea	District, Bioko	2002	3218	NS	All	Cataract (61%)	Macular Affection (21%)	Slit lamp	Moser <i>et al.</i> (2002)
Kenya	District, Nakuru (RAAB)	2007	3503	92.6	≥50	Cataract (42%)	PSED (30%)	Direct ophthalmoscope	Mathenge <i>et al.</i> (2007)
Kenya	District, Nakuru	2012	4414	88.1	≥50	Cataract (45%)	PSED (32%)	Slit lamp/fundus camera	Mathenge <i>et al.</i> (2012)
Malawi	District	2011	3430	95.7	≥50	Cataract (48%)	Glaucoma (16%)	Direct ophthalmoscope	Kalua <i>et al.</i> (2011)
Nigeria	National	2009	13599	89.9	≥40	Cataract (43%)	Glaucoma (17%)	Slit lamp/fundus camera	Abdull <i>et al.</i> (2009)
Nigeria	Local Government Area	2008	2424	93.6%	≥50	Cataract (46%)	Surgical complications (20%)	Direct ophthalmoscope	Rabiu (2008)
Rwanda	Western province	2007	2206	98	≥50	Cataract (65%)	PSED (20%)	Direct ophthalmoscope	Mathenge <i>et al.</i> (2007)
South Sudan	District	2006	2499	84.6	≥5	Cataract (41%)	Trachoma (35%)	Torch	Ngondi <i>et al.</i> (2006)
Tanzania (Kilimanjaro)	Regional	2010	3436	95.5	≥50	Cataract (51%)	PSED (36%)	Direct ophthalmoscope	Habiyakire <i>et al.</i> (2010)
Tanzania (Zanzibar)	Island	2007	3160	98.8	≥50	Cataract (67%)	PSED (25%)	Direct ophthalmoscope	Kikira (2007)
Uganda	15 neighbouring villages	2002	4076	98.9	≥13	Glaucoma (39%)	Cataract (23%)	Direct ophthalmoscope	Mbulaiteye <i>et al.</i> (2002)

NS, Not stated. RAAB, rapid assessment of avoidable blindness, PSED, posterior segment eye disease. All studies were cross-sectional, population-based studies, which used cluster random sampling.

diagnosis is confirmed, there is still debate on the best management in the context of limited resources and prospects for long-term follow-up (Quigley *et al.* 2000). Narrow-angle glaucoma prevalence is not well reported in African populations, this is in large part due to gonioscopy not being performed in the frequently used RAAB methodology and also in other more comprehensive surveys (Mathenge *et al.* 2012).

People of African descent (not living in Africa) have a higher prevalence of glaucoma, are more likely to develop glaucoma at an early age with more aggressive disease and have a higher risk of glaucoma related blindness than Caucasians or Asians (Mason *et al.* 1989; Tielsch *et al.* 1991b). It is therefore vital that the epidemiology of glaucoma is investigated in more detail in various populations in Africa.

Comprehensive reviews on glaucoma in Africa were published in 2009 (Cook 2009) and 2013 (Kyari *et al.* 2013), no new data from African population-based studies have since been published since 2009. The authors are aware of awaited data to be published from study groups in Nigeria (Dineen *et al.* 2008), Ghana and Kenya (Mathenge *et al.* 2012).

Current data on glaucoma underestimate the true prevalence, as many cases of glaucoma have preservation of central vision and do not include visual field assessment (Cook 2009). Furthermore, preferential coding of cataract due to its reversible nature often means that glaucoma is not assigned as the primary cause of blindness in a patient with visual loss from coexistent glaucoma and lens opacity, as per WHO criteria (World Health Organization 1988).

Incidence. It is assumed that incidence of glaucoma in Africa will most closely reflect that of the Barbados Eye Study, whose enrolled participants were of West African descent (Leske *et al.* 2001, 2007). All other studies with data on glaucoma incidence have been conducted in largely Caucasian populations: the Ponza Eye Study (Cedrone *et al.* 2012), the Dalby Eye Study (Bengtsson 1991), the Blue Mountain Eye Study (Chandrasekaran *et al.* 2006), the Melbourne Visual Impairment Study (Dimitrov *et al.* 2003) and the Rotterdam Eye Study (de Voogd *et al.* 2005). Annual incidence of new glaucoma in these studies varied from 0.1 to 0.6%, the highest being in the Barbados Eye Study which was largely made up of people of African descent. To date, no data on incident glaucoma or glaucoma progression from population-based studies in Africa are available.

Diabetic retinopathy in Africa

Prevalence. Diabetes is a major threat to global public health. The estimated prevalence of diabetes worldwide

was 285 million in 2010, representing 6.4% of the world's adult population, with a prediction that by 2030 there will be 438 million people with diabetes (DF 2009). The most substantial increases (7 to 15 million, 111%) are expected to be in Africa and the Middle East as a result of various factors including population growth, ageing, urbanisation, dietary changes and the increase in obesity and sedentary lifestyles in these regions (King & Herman 1998).

Although no data exist from population-based studies (PBS) in Africa directly comparing ethnic variation as a risk for DR, a hospital-based study in South Africa estimated the prevalence of DR amongst patients with adult-onset diabetes attending a large community hospital to be similar in patients of African (37%), European (41%) or Indian (37%) heritage. However, 'severe DR' (study specific classification) was significantly more frequent in Africans (52%) and Indians (41%) than Europeans (26%; Kalk *et al.* 1997). The predicted rise in proportion of adults suffering from diabetes will inevitably lead to an increase in the prevalence of DR (Williams *et al.* 2004).

The detection of DR in Africa remains a challenge in part due to a lack of necessary equipment and skilled manpower (Rotimi *et al.* 2003). The authors of this review [also cited in reference: (Burgess *et al.* 2013)] identified two high-quality, population-based, cross-sectional studies reporting DR prevalence in Africa (but not SSA). The Diabetes in Egypt project (1993; Herman *et al.* 1998) reported the proportion of DR and PDR in individuals with diabetes to be 31.6% and 0.9%, respectively. The Mauritius diabetes complication study (Dowse *et al.* 1998) reported 30.2% DR and 1.3% PDR; the prevalence of PDR in subjects with known diabetes was 2.3%. These figures are comparable with prevalence estimates reported in recent American and European studies.

Egypt and Mauritius are ethnically and demographically very different to most countries of sub-Saharan Africa; the findings of these studies should be generalised to other settings with caution.

There are also estimates of the prevalence of DR amongst diabetics from high-quality clinic-based studies in Africa. Very high prevalences of DR, PDR and maculopathy have been reported. A study from Malawi reported 32.0% DR, 5.7% PDR, 15% sight-threatening maculopathy (Glover *et al.* 2012). Two separate studies from South Africa have found comparable results: Mash *et al.* found 62.4% DR, 6.1% PDR and 15.2% with any maculopathy (Mash *et al.* 2007); Rotchford *et al.* found DR 40.3%, PDR 5.6%, 10.3% CSME (Rotchford 2002).

Evidence from unpublished data supports urbanisation as a risk factor for DR. Slit-lamp assessment of the retina assessing DR in a South-African PBS (Rotchford &

Johnson 2002; Rotchford *et al.* 2003) demonstrated a 0.7% prevalence of DR (NPDR 0.6%, PDR 0.1%) in rural communities and a 2.1% prevalence of DR (NPDR 1.8%, PDR 0.3%) in urban communities (A. Rotchford, unpublished data).

Estimates of the proportion of African patients with diabetes who are visually impaired are high even compared with older European and American studies. The population-based Nigerian national blindness and visual impairment survey was conducted between 2005 and 2007 (Abdull *et al.* 2009). DR was identified as the primary cause of visual impairment in 0.29% of 3129 subjects with uncorrected VA worse than 6/12 and in 0.5% of those with acuity less than 3/60. This study is likely to underestimate the visual impact of DR as examiners were instructed to preferentially record treatable, rather than preventable, causes of visual impairment.

Incidence. No population-based cohort study was identified providing incidence data on DR in SSA. However, two cohort studies of DR in Africa were identified by this review, one of which was in SSA. A survey of diabetes complications in Mauritius was followed up 6 years later (Dowse *et al.* 1998). Of subjects with diabetes in the initial survey 40.5% were re-examined for DR (Tapp *et al.* 2006). Six-year incidence of DR was 23.8%. Duration of diabetes and fasting blood glucose were independently associated with incidence of retinopathy. Six-year progression to PDR was reported from no DR (0.4%), mild NPDR (5.2%) and moderate NPDR (29.4%).

In South Africa, a cohort of patients with insulin-dependent diabetes mellitus (IDDM) diagnosed before age 30 years was followed up over time (Gill *et al.* 1984). In those subjects seen after 10 years of follow-up, prevalence of DR had increased from 6% to 52% and PDR from 0 to 3% (Gill *et al.* 1995). In subjects seen at 20 years, prevalence of DR had increased from 12% to 59%. No incidence data were collected (Gill *et al.* 2005).

No other prospective cohort studies were identified. However, a study reflecting cumulative incidence of DR from South Africa (Distiller *et al.* 2010) reported on 1520 type 1 and 8026 type 2 patients who had maintained membership for ≥ 5 years in a community-based, privately funded diabetes management programme. In type 1 participants, the prevalence of any retinopathy at baseline and at 5 years was 22.3% and 28.0%, respectively, and in type 2 participants 20.5% and 26.6%, respectively.

Age-related macular degeneration in Africa

Prevalence. The majority of data globally on AMD are from Caucasians and Asian populations (Vingerling *et al.*

1996; Cruickshanks *et al.* 2001; Buch 2005; Buch *et al.* 2005; Munoz *et al.* 2005; Arnarsson *et al.* 2006; Chen *et al.* 2008; Yasuda *et al.* 2009; Choudhury *et al.* 2011) with a paucity of data from peoples of African descent. Data on Africans are largely from studies undertaken in African populations living outside of the African continent (Leske *et al.* 2004, 2007). Comparative data between Caucasians and Africans living in the same geographical area have suggested differing predispositions towards AMD (Sommer *et al.* 1991). A single population-based study based in SSA (Kenya) determining the prevalence of AMD was identified (Mathenge *et al.* 2013). Early and late AMD prevalence in adults aged 50 years and above was 11.2% and 1.2%, respectively, amongst participants graded on digital retinal images ($n = 3,304$). After controlling for age, women had a higher prevalence of early AMD than men (odds ratio 1.5; 95% CI, 1.2–1.9), and the overall prevalence rose significantly with each decade of age (Mathenge *et al.* 2013).

Incidence. The incidence of AMD has been reported in population-based studies in the Americas, Australasia, Europe, and Asia; however, no data exist from the African continent to date. With the exceptions of the Latino Eye Study (Varma *et al.* 2010) and the Barbados Eye Study (Leske *et al.* 2004, 2006), all data are in Caucasian populations, and inferred data from the Barbados study suggest incident early AMD is similar to elsewhere in the world, but late AMD is less common, possibly suggesting a protective mechanism.

Discussion

We found through our review of the literature that PSEDs are an important cause of vision loss in SSA countries. Selection bias may have led to information from French- and Portuguese-speaking countries being omitted; data from Egypt and Mauritius are unlikely to be representative for the SSA, and data not in the peer-reviewed literature were also omitted and may have been a source of bias.

The detection of and treatment for PSED poses many challenges to countries that currently lack the necessary infrastructure and resources. VISION 2020 has placed priority on conditions deemed more straightforward to treat, and this strategy has proven largely successful.

PSEDs differ from the leading anterior segment eye diseases (cataract and refractive error) in prevention/treatment, as no cures currently exist (with the exception of angle closure glaucoma). Surgical intervention can restore vision in those visually impaired from cataract, and

provision of glasses can restore or improve vision in people with refractive error. However, established visual loss from PSED is difficult to reverse, and for most conditions, there is no 'curative' treatment.

Medical and/or surgical intervention for glaucoma can slow disease progression and thereby reduce the risk of further sight loss (Heijl *et al.* 2002). Systemic control of diabetes mellitus, retinal laser treatment, intravitreal injections and vitreoretinal surgery in sight-threatening DR can stabilise and, to some degree, improve DR status and thereby also prevent sight loss (1993). Currently no cure for AMD exists, although intravitreal therapy is available for end-stage wet AMD (approximately 10% of all AMD cases). The infrastructure required to detect AMD and deliver treatment as well as the cost of treatment itself is currently prohibitively expensive for use in most LMIC settings but is widely used in high-income countries (Bowler *et al.* 2012). Vitamin supplementation has shown some evidence of risk reduction in progression of subtypes of AMD (Evans 2006), but not prevention of AMD (Evans & Lawrenson 2012) and again may be prohibitively expensive.

This review suggests that PSEDs account for a large proportion of people with vision loss living in SSA. In recent years, improved methodologies and understanding may account for some increase in estimates of prevalence. In particular, the affordable RAAB methodology (Dineen *et al.* 2006) has led to increased numbers of researchers undertaking population-based surveys in SSA.

The majority of existing data on NCDs, including PSED, from LMIC are from cross-sectional studies providing valuable data on prevalence and risk factors. Longitudinal studies provide the opportunity to investigate the natural history of diseases, which is necessary in developing health policies at local and national levels. Few longitudinal cohort studies from LMIC have been conducted due to barriers including expense, complex logistical planning and political challenges.

A change in the focus of programme managers and policymakers over the coming decades is required if the prevalence and incidence of PSED in SSA increases as predicted. This increase is likely with extended life expectancies and success of the VISION 2020 in the treatment for anterior segment eye diseases and infectious diseases of the eye. Urbanisation and westernised lifestyles may also play a role in diseases such as diabetes and consequently DR.

Many studies worldwide have collected cross-sectional survey data on PSED prevalence; however, few studies have data on incident PSED with no SSA-based eye disease cohort studies to date. The best estimates of incidence for Africa are therefore extrapolated from studies

conducted elsewhere in the world. Furthermore, investigating PSED in Africa offers a new perspective on account of the different exposures and genetic make-up of these populations compared with those studied thus far, which may reveal new insights into the cause and natural history of these diseases.

Inferring data from high-income countries undermines efforts to establish studies in LMIC, which will guide the effective use of minimal existing resources to deal with the growing burden of NCDs.

Large, community-based cross-sectional and cohort studies are needed to estimate prevalence of disease, risk factors for disease, as well as incidence and progression across Africa. Evidence for effectiveness and economics of screening of and treatment for PSED in low resource settings is vital for health service planners.

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Chapter 2: Management of glaucoma and challenges in management in Africa

Challenges of glaucoma treatment and outcomes in Africa

Glaucoma treatment

Of all the risk factors for glaucoma, the only modifiable risk factor is IOP. Lowering the IOP has been associated with reduced progression of visual field defects. [55] Many different treatments exist and most aim to reduce IOP. These options are: topical or systemic medication; surgery, which involves creating a fistula to increase outflow of aqueous humour; Laser treatment used to either decrease the production of aqueous or increase the outflow facility. Some other medications such as Memantine do not lower IOP but may provide some neuroprotection to the optic nerve though there is lack of compelling medical evidence.[56, 57] Blacks are less responsive to both medical and surgical treatment for POAG.[58]

Medical treatment

The medical treatment options use different classes of drugs, which include: prostaglandin analogues, such as latanoprost; Beta-blockers such as Timolol; carbonic anhydrase inhibitors which can be oral e.g. acetazolamide or topical e.g. brinzolamide and dorzolamide; alpha-adrenergic agonists such as Brimonidine; sympathomimetics such as Epinephrine; parasympathomimetics, such as Pilocarpine; and hyperosmotic agents such as mannitol. Drugs can be used in combination. New treatments under investigation include Punctal Plug Delivery Systems and use of nanoparticles for drug delivery.

Topical ocular hypotensives are the most frequently used and are effective not just in treating high IOP, but in delaying or preventing the onset of POAG in African American individuals who have ocular hypertension.[59] Studies in blacks show that Bimatoprost achieved slightly more clinically relevant IOP reductions than Travoprost, [60] or that there is no difference between whites and blacks [61] though there is a higher post-treatment inter-visit IOP range in African-Americans.[62] In another study there was no difference in IOP response to non-selective beta-adrenergic antagonists between African

American and white participants, but responses to prostaglandin analogues was slightly greater in African American though the difference was not statistically significant.[63]

Whatever type of medicine is prescribed, it is important that patients are given the correct prescription and obtain the drug prescribed, store it in an ideal environment, use the drugs as prescribed at their right times and continue to do so as instructed. Storage of medications could also be a problem in warm climates, but a study of Latanoprost stored at 30°C for four weeks after opening the bottle remained as effective and safe as that stored under cold conditions.[64]

Surgical treatment

The surgical options are trabeculectomy with or without [65] antimetabolites like Mitomycin C and 5-Fluorouracil which are used where the risk of failure due to excessive scarring is high. Other surgical procedures are trabeculotomy, goniotomy and drainage implant surgery, and non-penetrating surgeries such as canaloplasty and new minimally invasive surgical techniques.

Trabeculectomy is the operation of choice in African populations [65-67] where it offers good IOP control in 70-80% of patients (Table 2). Trabeculectomy has a higher risk of bleb failure in blacks from excessive scarring than in Caucasians eyes. The risk of failure is high especially if no antimetabolites are used. Therefore the use of antimetabolites is recommended as safe and effective in controlling IOP in many cases.[68, 69]

Antimetabolites or anti-scarring agents e.g. 5-FU,[70] mitomycin C[69] and β radiation[71] have been employed to reduce surgical failure, but all are associated with complications such as hypotony and bleb infection. Other reasons have been proposed for the high failure risk of trabeculectomies in black populations, one being that black conjunctiva has more wound healing cells which promote scarring after surgery, [72] although this is not supported by convincing evidence.[73] The outcome of trabeculectomy in Africa is variable, offering good IOP control in 30-97% of patients. Table 2 shows the outcome of trabeculectomy in different African populations.

Laser treatment.

The laser treatments used include, Argon Laser Trabeculoplasty (ALT), Diode laser trabeculoplasty, (DLT) Selective Laser Trabeculoplasty (SLT) and cycloablation with either endo or transscleral diode laser cyclophotocoagulation and Nd-YAG cyclophotocoagulation

Laser trabeculoplasty increases outflow of aqueous and offers good short term IOP control. [74-77] An editorial on trabeculoplasty and trabeculectomy and race recommended that the first surgical intervention in patients with “advanced glaucoma” should be trabeculectomy in whites, and ALT in blacks. [78] Trabeculoplasty can also be performed using diode laser i.e. diode laser trabeculoplasty (DLT). Diode laser trabeculoplasty and ALT are equally effective in lowering IOP in eyes with uncontrolled glaucoma on maximally tolerated medical treatment. [75]

Cyclodestruction has been in use for refractory glaucoma especially for pain relief. Cyclodestruction is usually carried out with the diode or Nd-YAG lasers through the sclera or under direct vision combined with cataract surgery (endocyclophotocoagulation). Trans scleral diode laser cyclophotocoagulation is receiving increasing support not only for eyes with refractory glaucoma but also those with uncontrolled IOP with residual good vision. [79-82] The procedure is minimally invasive and can be carried out under local anaesthesia as a day case. There are some safety concerns however, most importantly hyphaema, choroidal detachment or long term hypotony. Table 3 below shows the outcome of diode laser cyclophotoablation in a range of studies while table 1B in chapter 7 also outlines the complications leading to decreased vision in many studies.

Glaucoma treatment recommended in Africa

Which treatment is given depends on several factors, e.g. stage of disease at presentation, the socio-economic and demographic features of the patient (level of awareness, family support, household economic situation, distance to health facility etc.), the resources available and the preference of the patient. A once-off treatment, surgery or laser, is probably the best option for advanced disease in many Africans, those who are poor and lack support, and where facilities for monitoring and follow up are lacking or the patient is not motivated. [83-85] Although surgery has been demonstrated to be the operation of choice, acceptance is poor in African patients,[86] mainly because of fear and the lack of visual improvement after the surgery. [84] Combined cataract and trabeculectomy has, therefore, been advocated for this reason in Africa, even if there are only minimal lens opacities, so that patients experience some improvement in their vision after surgery. [87]

Table 2. Outcome of trabeculectomy in Africa

S/ N	Publicati on	Year of pub.	Place of study	Type of study	Age range (years)	Follow up period (mths)	No. of eyes	Outcome (IOP<20),	Post. op. follow up %	Remarks
1	Thommy et al.[88]	1997	Zaria, eria	Case series Trabec	36-72	6-19	139	95.40%	71 at 6mths	
2	David R et al[89]	1979	South Africa	Case series Trabec	35-75	6-30	49	73%		
3	Moriarty B J et al.[90]	1988	Jamaica	Case series ALT		12	48	68% success at 12mths		
4	Sandford S.[91]	1978	Zaria, Nigeria	Case series Trabec	>3	>3		Trabec 65%, Sclerotomy 60%		
5	Mwanza JC et al.[69]	2001	Kinshasa Congo	Case series Trabec ±mmc		20	11 mmc, 11 no mmc	with mmc81.8%, no mmc 63.6%		
6	Quigley HA et al.[92]	2000	Kongwa, tanzania	Case series Trabec ±mmc	≥40	36	20	mean IOP dropped from 29.9 to 14.9 in 89%	90% at 3 years	
7	Singh K et al. [93]	1998	Ghana	RCT, Trabec+5FU or+mmc		mean 17.7	101	Overall mean pre- and postop. IOPs were 30.1 and 15.9		
8	Kirwan JF et al. [94]	2006	South Africa	RCT	≥40	12	164 trabec+β- irradiatio n, 156 trabec+pla cebo	5% risk of failure in trabec+β-irradiation 30% risk of failure in trabec+placebo(IOP>21m mHg)		Cataract risk

9	Shah P et al.[95]	2011	African Caribbean s	Prospective case series Trabec+mmc		48,6	47	IOP< 21, 92% without med.Rx 59% with med. Rx		
10	Grieshaber MC et al.[96]	2010	Pretoria, South Africa	Case series Canaloplasty		mean = 30.6 +/- 8.4 months	60 random eyes of 60 pts.	Mean preop. IOP= 45.0 +/- 12.1 mm Hg 12 mths = 15.4 +/- 5.2 mm Hg 24 mths = 16.3 +/- 4.2 mm Hg 36 mths = 13.3 +/- 1.7 mm Hg		complete success rate was 77.5%
11	Preussner et al[97]	2010	Western Cameroon	Prospective Case series 960nm controlled laser.	16.8 - 88.8 Med.age = 63.7		272 eyes of 188 patients	IOP reduction after 1 year = 7.5 mmHg Ave. glaucoma drug reduction from 1.5 to 1.2 substances	26 eyes (of 18 patients) at 1 year	940nm laser safe for prim Rx in African eyes
12	Kim HY.[98]	2008	Cape coast, Ghana	Retrospective comparative Crosssectional follow up	mean 65.9 mean 64.7	36	38 trabec+5FU30 Trabec+mmc	52.6% (IOP<21mmHg) 73.3% (IOP<21mmHg)		
13	Agbeja-Baiyaroju A M et al.[99]	2001	Ibadan, Nigeria	Retrospective			433	92%		
14	Ashaye AO et al. [100]	2009	Ibadan, Nigeria	Retrospective	30-73 mean 49.4	12	76	79.4		no diff 5FU or not

15	Lawan A.[101]	2007	Kano, Nigeria	Retrospective	18-75	24-84	71	97% (IOP<21mmHg)		21% presented blind, 1/3 had VCDR o.9
16	Verry JD et al.[102]	1990	North-East, Ghana	Retrospective	Range 10->50 26%<40 years	76% at 6 months	397 patients	(IOP <22mmHg) Med. Rx =17% Surg. Rx = 84%	19% at 6 months	71% males 52% blind at presentation
17	Bowman, R. J. et al.[87]	2009	Dar es Salam, Tanzania	Retrospective for Combined cataract sur+ trabec	Mean= 67 range 21-86(69%men)		163 patients. PT in 80% SICST in 6.1% ECCET in 14.1%	70% patients had improved visual acuity pre-operatively. 62% patients had follow-up IOPs of 6-15 mmHg and 85% had follow-up IOPs of 6-20 mmHg.	66% follow-up (mean interval 104 days),	Presenting VA in the op. eye =6/60 in 93% <3/60 in 47% Mean presenting IOP =28 mm Hg Pre-op CDR o.8 in 85%
18	Woodcock MG et al.[103]	2008	Capetown, S/Africa	Retrospective intervention al review of consecutive single-phase Molteno tube implantation		mean = 2.9 years	162 implants in 157 eyes of 148 patients	IOP mean of 43.3 at booking to 19.1 at final follow-up 'complete success' = 30% 'partial success' =16%	2.9 years	Pseudophakic pts control.Neovascular glaucoma = risk factor for poor control. Race, gender, etc no influence on surgical outcome

19	Egbert PR et al. [104]	1993	Ghana	RCT	-	Mean 282 days	24 with 5FU 31 without 5 FU	5FU=83% (IOP<20mmHg), Without 5FU=39%	39% of the controls successful at 1 year	
20	Yorston D et al. [70]	2001	Tanzania	RCT			68	At 6 months mean IOP 17,4mmHg in placebo and 16.9mmHg in 5FU	Risk of failure at 2 years placebo 70%, 5FU 88%	

Table 3: Outcome of diode laser cyclophotocoagulation in Africa and other places

Referen ce and Study type	Type of glaucoma	Participants and methods				Outcomes			
		Indications	Numbe r treated	Definition of outcome	Preoperati ve IOP (range)	Follow up	Post op IOP	Visual acuity	Other post op findings
This study	POAG, Seeing eyes	Lower IOP	181 eyes	<22mmHg	37mmHg	1 year	19 mmHg at 6 months 19 mmHg at one year	70% retained 13% improved 18% deteriorated Two or more lines	43% follow up rate at one year
Mavraka nas[105] Retrospe ctive Africa	POAG (seeing and non seeing)		49 eyes	Lowered IOP	Mean 53mmHg		At last visit 51% >50% reduction in IOP		
Egbert [106] Prospecti ve, Ghana	POAG	Primary treatment	92 eyes	IOP reduction	Mean 29.3 (16-66)	Mean 13.2 months	20% or more drop in 47% Final IOP <22 mm Hg in 48%.	VA reduction 23%	

Rotchford[79] Retrospective	POAG seeing eyes	Primary treatment	49 eyes	Loss of 2 or more VA line IOP 8- 21	28mmHg (16-50)	5 years	79.6% controlled at final follow up	30.6% loss of 2 or more lines 67% retained VA or better	
Ghosh[107] prospective	POAG seeing eyes	High IOP	46 eyes	24months follow up	Mean 24mmHg	24months follow up	Mean-17.2 (12-28) 84.8%IOP<21mmHg	76.1% retained VA 23.9% lost >2lines	
Kucher[108] Prospective (micropulse)	Advanced glaucoma	Uncontrolled IOP	19 eyes	6-21 mmHg or a reduction by 20 % at last follow- up	Mean 37.9 mmHg	Mean 60.3 days	22.7 mmHg at last follow-up, 40.1 % decrease.	21% gained 21% lost one line of VA	
Butt[109] quasi- experimental study	POAG	POAG and Maximum medication Primary Rx	60 eyes	IOP and medication reduction,	mean 41.62 (28 – 60) mm Hg	1 year	Mean 15mmHg at 6 mths 14.15mmHg at 1 year	Not reported	

Bloom[10] RCC	Refractory glaucoma		45 eyes		Mean 32mmHg		Mean 19.3mmHg 71% treatment success	VA reduced by 2 lines in 9%	
Ansari[82] Retrospective	Non refractory glaucoma	Inadequate control Allergy to medication unwilling to surgery, painful, blind eye	74 eyes	IOP lowering and drop in glaucoma medicines	Mean 40.3mmHg	12.5 months (4-30 months).	Mean (was reduced by 45.1% to 21.1 mmHg at the final index visit 52% reduction in glaucoma drops	Mean VA preserved in those with good vision with 13% decrease	58% reduction in glaucoma drops
Spencer[11] Prospective	Refractory glaucomas	Uncontrolled Reduction in meds Unlikely or surgery refusal	58 eyes	Reduction of antiglaucoma medicines	Mean 33.0 mmHg	Mean 19 (6-37 months)	Mean IOP at final index visit 16.7 mm Hg	32% lost more than two lines of Snellen acuity	antiglaucoma medication score reduced from 2.4 to 1.4

Martin[112] Prospective	Painful blind glaucomatous eyes	Pain	30 eyes	IOP reduction Pain relief	Mean 51 mm Hg	6 months	26 mm Hg Pain relief in 73.3%	Not reported	
Kramp[113] Retrospective	POAG or secondary glaucoma	Uncontrolled	193 eyes	IOP 10-22 mmHg	Mean 24.6+/-6.7 mmHg	Mean 13.9 months (6 to 48 months)	Success 76.4% Mean 19.3+/-5.7 mmHg Best results seen in POAG	No report	
Murphy[114] Retrospective	Refractory	Uncontrolled	263 eyes	IOP < 22 mm Hg or > 30% drop in IOP	Mean 40.7 mmHg		Mean 17.7 mmHg A reduction of 52.6% Success 89%	Not reported	
Lai[115]	CACG	Medical uncontrolled CACG	13 eyes	IOP < 21 mmHg with or without medications	Mean 36.4 +/- 12.6 mm Hg	Mean follow-up 26.5 +/- 4.2 months.	Success 92.3% Mean IOP 18.7 +/- 12.2 mm Hg at final follow-up	Maintained 15.4% or improved 46.2%	

Grueb[116] Retrospective	POAG, PEG	POAG, PEG	90 eyes	4-18mmHg or 20% reduction	Mean 21 mmHg (12-36 mmHg)	24 months minimum	Mean 16 mmHg (9-27 mmHg) Success 36.7% all 40.9% POAG	Not reported	
Vernon[117] Retrospective	Refractory glaucomas	Poor control	42 eyes	IOP<22 Reduction in medicines	Mean 31.4mmHg	Mean 65.7 (36-84 months)	88.1% success 50.3% reduction in IOP Mean 15.6 +/- 6.3 mmHg	Maintained 26.2% Improved 9.5% Deteriorated 64.3%	medications dropped from 2.55 to 1.71
Iliev[118] Retrospective	Advanced, refractory	Refractory glaucoma	131 eyes	IOP 6-21 at last visit	Mean IOP 36.9mmHg	Mean 30 months	Success in 69.5% at last follow up 45.8% successful IOP control at first treatment,	Not reported	Mean number of medications decreased from 2.97 to 1.39
Raivio[119] Retrospective	Various types	Poor control Refractory	60 eyes	8-21mmHg	IOP 27 ± 11 mmHg	26 months (3-75 months).	18±5mmHg at 6months, 19±7mmHg at 1year, 80% reduction of 30% IOP at last follow up	Not reported	

Frezzoti[120] Prospective	Advanced Refractory	Refractory	124 eyes	IOP 5-21 Pain relief	Mean 29.9 +/- 8.4 mmHg (17-58 mmHg)	17 months (3-42)	20.8 mmHg (range 6-45) last follow up	Not reported	
Zhekov[121] Retrospective	Refractory		87 patients		IOP 39.5mmHg	3 years	17.8 at 6 weeks maintained over 3 years	VA unchanged or better in 83.6%	

Acceptance, adherence to treatment and follow up

Adherence to treatment for glaucoma

A meta-analysis of observational studies showed that good adherence to drug therapy is associated with positive health outcomes.[122] The literature has many definitions for medication-taking behaviours. The common everyday interpretation of compliance is the passive following of doctors' orders while adherence is the extent to which a person takes medication as prescribed by the doctor. Concordance is described as consultative and consensual partnership between the patient and their doctor, and persistence is the person's ability to continue taking medications for the intended course of therapy as prescribed by the doctor. Many no longer accept the term compliance: "The modern attitude to the word is that it betrays a paternalistic attitude towards the patient on the prescriber's part and that it should not be used". (Aronson 2007 pp.383-384) [123] A more formal definition has been proposed that medication compliance may be defined as "the extent to which a patient acts in accordance with the prescribed interval and dose of a dosing regimen." (Cramer, 2008 pp.45-46) Compliance is measured over a period of time and reported as a percentage, and medication persistence may be defined as "the duration of time from initiation to discontinuation of therapy" (Cramer, 2008 pp.45-46) [124] The World Health Organization (WHO) Adherence Project has adopted a definition of adherence to long-term therapy as the extent to which a person's behaviour – taking medication, following a diet, and/or executing lifestyle changes, corresponds with agreed recommendations from a health care provider.[125] The National Coordinating Centre for the National Health Service (NHS) Service Delivery and Organization Research & Development (NCCSDO) reports adherence as the term of choice to describe a patient's medicine taking behaviour. Adherence to treatment is a big problem not just in African or Black communities, but globally. The report also mentions that reviews conducted across disease states and countries are consistent in estimating that between 30-50% of prescribed medication is not taken as recommended.[126]

Inadequate adherence with glaucoma eye drops is universal.[127] A recent review reported that up to 80% of glaucoma patients deviate from the regime prescribed. [128] [126] [127] Another study using an electronic dosing aid found significant differences for adherence rates between patients of European descent and those of African descent. Patients of African descent demonstrated poorer adherence for all three definitions used in the study.[129] Adherence to glaucoma medication is now receiving more attention in terms of risk factor studies as well as interventions to improve adherence [130-138]

including trials of patient education. [139] A Cochrane Systematic Review in 2009 identified eight clinical trials designed to improve adherence with topical medication for glaucoma, none of which were undertaken in Africa. [136] Age is an inconsistent factor in adherence: in one study younger people were more likely to be non-adherent to glaucoma medication.[140] But it has been demonstrated that that older age was not a consistent risk factor for poor adherence to glaucoma medication.[141]

Poor medication adherence has also been associated with visual field progression.[142, 143] Trust in physicians was slightly higher in whites than blacks but this was not associated with glaucoma medication adherence.[144] There are many recommendations to improve adherence to glaucoma treatment, including that physicians should incorporate adherence counselling broadly into their practices.[145] Many patients exhibit 'white coat' adherence in which patients' adherence rises sharply one week before their appointment and then declines rapidly afterwards. This creates a decision dilemma for the ophthalmologist who may conclude that the particular regime is not adequate. This leads to unnecessary changing of eye drops or treatment options. An editorial on glaucoma medication adherence reports that proper adherence to a prescribed glaucoma medication regimen involves at least four steps: patients must obtain the medication; successfully instil the drop into the eye; use the medication at the appropriate time; and do so each day. These four steps have been conceptualized into two domains: the tasks of acquiring the medication and proper dosing and the more physical task of instilling a drop into the eye. [146]

Patients are more likely to be adherent to treatment if they understand their disease, the rationale for treatment, and have a simplified treatment regime.[147] In a Finnish study, support from physicians and nurses, and being informed of the consequences of treatment was associated with greater adherence.[148] In-depth interviews conducted in glaucoma patients receiving treatment from two hospitals in Southeast United States showed that non adherent participants were less likely to believe their eye doctors spent sufficient time with them, ask their eye doctor if they had any questions, know the benefits of taking their glaucoma medication regularly, have someone help them take their glaucoma medications or drive them to eye appointments.[149] In a study to determine the extent of non adherence to treatment for glaucoma among elderly patient in a retrospective cohort study of 2440 patients older than age 65 who were enrolled in the New Jersey Medicaid Program, factors associated with non-adherence included the use of glaucoma medication requiring more than two administrations per day and the

presence of multiple other medications in the patient's drug regimen. Patients on multiple glaucoma medication were more adherent than those on a single agent and age and sex were not predictors of non-adherence.[150] In another US study of glaucoma patients starting treatment, nearly half had discontinued all topical ocular therapy within six months, which fell to 37% at three years.[151] Another study showed that patients prescribed once daily treatment were more likely to be adherent than those where a second medication had been added.[152]

Literacy has often been associated with adherence to medication. For example, a study in the US showed that people with open angle glaucoma and low levels of literacy were less adherent than those with higher levels. Adherence to medications can be enhanced by education of patients and family members, improved dosing schedules, increased accessibility to healthcare, and improved provider-patient relationships (e.g. increased trust).[153]

Improving medication adherence.

Physicians should presume that patients have low adherence to their treatment and give clear and precise information about the expected benefits of treatment, the disease, and risks of progression.[154]

Many techniques have been used by many health care providers to improve adherence to medication in their patients for many different diseases or health conditions. These may be general or aimed at specific target groups e.g. by age or level of education etc. One of these uses the AIDES acronym which is built on the principles of completing a comprehensive medication Assessment; partnering with patients to ensure Individualization of the regimen; choosing appropriate Documentation; providing accurate and on-going Education tailored to the age group and needs of the individual; and continuing Supervision after initiation.[155] Another system that has been used is the motivational interview method, which has been used in many health settings and has shown promise in psychiatry, HIV care and hypertension (see further discussion below).[156-159]

Acceptance of glaucoma surgery

Acceptance of glaucoma surgery is a problem in Africa for many reasons. Most important is that the patients perceive no visual improvement after the surgery or are

afraid of the surgical procedure itself. There are very few studies about acceptance of treatment in Africa as most studies focus narrowly on the outcome of those who have undergone surgery. In a study undertaken by the researcher in Northern Nigeria, acceptance of surgery was just 8% in patients in whom surgery was recommended as the treatment of choice.[160] Rumours may play an important role. In Kenya, those who accepted cataract surgery generally reported that people they knew had had a good outcome while those who refused surgery often knew someone whose vision worsened or even become blind after surgery. Many of these 'failed cases' were prominent figures in the local community. On being re-interviewed, several people admitted that they had actually never met someone who had undergone unsuccessful surgery but had only heard rumours.[161]

A trial of health education in India of glaucoma patients offered early surgery or medical management, showed that acceptance of early surgery was higher amongst those receiving health education (65%) than those receiving usual care (35%). The study also showed that early surgery gave better IOP control than medical treatment.[162]

Follow up

Poor follow up is another very important problem that affects the management of glaucoma patients in Africa. In Ibadan, Nigeria 60.5% of glaucoma patients who were not blind failed to attend for follow up. The main reasons for defaulting were that they used the medicines and they felt all right, transport problems, fear of surgery, feeling better or no change with treatment. Patients who were more likely to dropout were younger, male, or they lived far away from the clinic. Patients with severe disease were more likely attend for follow up.[163] In Ghana, only 19% of patients attended follow up at 6 months and only 17% on topical medication had IOPs <22 mmHg.[164] In Nigeria, 60% of glaucoma patients failed to attend the hospital after one year, with young males being likely defaulters.[163] [163]Demographic factors also affect adherence to follow up. In a study in a Glaucoma Clinic in San Francisco, being black was one of the factors independently associated with inconsistent follow-up (OR 7.16) as was lack of knowledge of the permanency of glaucoma blindness (OR 3.09) and not being counselled by glaucoma clinic staff (OR 3.6).[165] In India, independent predictors of poor follow-up included lack of formal education, poor adherence, and belief that follow-up is less important if one uses glaucoma medications and has no noticeable visual changes.[166] In another study in the US, black race, Latino ethnicity, unfamiliarity with the long-term

nature of treatment, lack of knowledge of the permanency of visual loss due to glaucoma and perception that it is not important to attend all follow-up visits were independently associated with inconsistent follow-up.[165] In a another study in African Americans in Connecticut, after screening for glaucoma, 69% complied with follow up, and 27% of these only came after being contacted once or more. In this prospective study, people who smoked, lived alone or had no car were less likely to comply with free follow up. Personal or family history of glaucoma had no significant impact on compliance.[167]

Stage at presentation of glaucoma and acceptance of surgery in Nigeria

Open angle glaucoma is painless and visual loss is gradual and insidious. In addition, in Nigeria there is a lack of primary eye care, which means that cases are not detected early, as occurs in high-income settings where adults often visit an optometrist. As a consequence people with glaucoma often present very late, frequently already blind in one eye with advanced disease in the other. This is reviewed in the paper titled:

1. Primary open angle glaucoma in northern Nigeria: stage at presentation and acceptance of treatment. Abdull MM, Gilbert CC, Evans J. BMC Ophthalmol. 2015;15(1):111.

Data were collected from the hospital where the PhD study was undertaken. The study was carried out to assess the extent of late presentation and acceptance of surgery in the study area.

Paper 4: Primary open angle glaucoma in northern Nigeria: stage at presentation and acceptance of treatment

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SECTION A – Student Details

Student	Mohammed M Abdull
Principal Supervisor	Clare Gilbert
Thesis Title	Adapted motivational interviewing to improve uptake of treatment in glaucoma patients in Bauchi state, Nigeria

If the Research Paper has previously been published please complete Section B, if not please move to Section C

SECTION B – Paper already published

Where was the work published?	BMC Ophthalmology		
When was the work published?	2015		
If the work was published prior to registration for your research degree, give a brief rationale for its inclusion	N/A		
Have you retained the copyright for the work?*	Yes, see appendix 5b	Was the work subject to academic peer review?	Yes

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Student Signature:

Handwritten signature of Mohammed M Abdull

Date: 15 December 2016

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Primary open angle glaucoma in northern Nigeria: stage at presentation and acceptance of treatment

Mohammed M. Abdull^{1,2*}, Clare C. Gilbert² and Jennifer Evans²

Abstract

Background: To determine the stage of primary open angle glaucoma at presentation at a tertiary eye unit, to assess patient's knowledge of glaucoma and acceptance and subsequent adherence to treatment.

Method: Information collected prospectively on new glaucoma patients aged 30 or more years included distance from residence and what they knew about glaucoma and its treatment. Treatment offered took account of disease severity and socioeconomic factors. Reasons for not accepting surgery were recorded. At follow up intraocular pressure (IOP) was measured and adherence to medication assessed verbally. Four categories of severity were defined based on visual acuity and visual fields defects in the worse eye.

Results: 131 patients were recruited (mean age 52.8 years; 62 % male). Most attended because of symptoms (70 %). Mean IOP in affected eyes was 31.9+/-SD 12.4 and mean vertical cup:disc ratio was 0.8. 99 eyes (47 %) had a visual acuity of light perception or worse. Risk factors for advanced/end-stage disease were age >50 years, living >10 km from the hospital, some awareness of glaucoma, not being literate, being unemployed and presenting with symptoms. In multivariable analysis older age and poor knowledge of glaucoma remained independent risk factors. 75 were offered trabeculectomy: five agreed but only one underwent surgery. Reasons for rejecting surgery were fear (37 %), preferred medical treatment (27 %) and cost (15 %). 32/85 (24 %) participants started on topical medication attended follow up. 72 % reported excellent compliance but only 56 % of glaucomatous eyes had IOPs less than 21mmHg.

Conclusions: To prevent glaucoma blindness strategies are required which promote earlier detection, with counselling to promote acceptance of and adherence to treatment.

Background

Glaucoma causes irreversible blindness in 4.6-6.7 million people worldwide [1]. In 2010 there were estimated to be 60.5 million people with glaucoma, which will reach 76.0 million by 2020 and 111.8 million by 2040. Primary open angle glaucoma (POAG) is the commonest form in Africa with the highest prevalence of any region (4.20 %; 95 % CI, 2.08-7.35) [2, 3]. The glaucoma-specific blindness prevalence in adults is estimated to be eight times higher in the two World Health Organization (WHO) African sub-regions than the Western Pacific region, which has the lowest prevalence [4]. In Nigeria, the prevalence of glaucoma is 5.02 % in adults 40 years

and above (Kyari F, Entekume G, Rabi M, Spry P et al. A population-based survey for the prevalence and types of glaucoma in Nigeria. The Nigeria national blindness and visual impairment survey. Submitted).

In many African patients, knowledge of the disease is poor as are acceptance of surgery and adherence to topical medication [5, 6]. Reasons for poor adherence include fear, lack of understanding that sight cannot be restored, and poverty. Community and family factors also contribute, as individuals' decisions about expenditure on health impact on family resources leading to considerable delay in accessing treatment, if at all [7, 8]. This means that patients often present blind and at a relatively young age, as has been reported from several countries in Africa (Table 1).

The purpose of this study was to determine the stage of POAG at presentation at a tertiary eye unit in Nigeria, to assess patient's knowledge of the disease and their acceptance and subsequent adherence to treatment, and to

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Table 1 Visual acuity in the better eye among patients presenting to eye units with glaucoma in African countries

Country	Year	N	Age (mean years)	% Blind	Other findings
Northern Ghana [7]	1990	397	ND	52 % blind (VAc)	
Dar es Salam, Tanzania [38]	2005	298	57	29 % blind (VAc)	CDR \geq 0.8: 70 %
Ethiopia [39]	2006	1,586	52	41 % blind (all glaucomas)	
Benin, Nigeria [40]	2006	154	53	25 % blind (VAc) 56 % blind (VFAc) 7	
Nigeria, Kano [41]	2007	71	18-75s	21 % blind (VAc)	Mean CDR 0.9; CDR \geq 0.9: 30 %
Yaoundé, Cameroon [42]	2008	184	62	34 % blind (VAc)	
Dar Es Salam, Tanzania [6]	2009	163	67	Operated eyes: 47 % blind; 93 % VA <6/60	Pre-operative CDR 0.8: 85 %
Upper East Region, Ghana [43]	2010	446	34	No data	CDR > 0.8: 70 % CDR = 1.0: 54.9 %
Nigeria: This study	2010	131	53	35 % blind (VAc)	Mean CDR: 0.8 CDR = 1.0: 44 %

CDR = cup:disc ratio; VAc = visual acuity criterion - presenting acuity <3/60 in the better eye; VFAc = visual field analysis criterion - central visual field of <10 degrees; PL = light perception; NPL = no light perception

explore associations between stage at presentation and mode of presentation and socio-demographic variables.

The study was undertaken in Abubakar Tafawa Balewa University Teaching Hospital, (ATBUTH) Bauchi north-east Nigeria. The catchment area (i.e. within 250 km) is arid, with a population of approximately 4.3 million. The majority are Hausa speaking subsistence farmers, and education levels amongst adults are low (e.g. 65.7 % literacy in any language; 26.6 % in English) [9]. Life expectancy is approximately 48 years [10]. Poverty levels are high and infrastructure in terms of roads, public transport and electricity supplies is poor.

Methods

For inclusion in this study, patients had to have POAG, have lived in the catchment area for at least 6 months, be aged ≥ 30 years, be a new glaucoma patient to the hospital (i.e. including referrals), be English or Hausa speaking and willing to participate. Those with additional causes of visual loss were excluded.

Potential participants were identified by examination based on symptoms at presentation, or by routine disc examination of all patients aged ≥ 30 years. For the latter, undilated disc examination was performed by direct ophthalmoscopy by one of two senior ophthalmic nurses or optometrists trained in optic disc examination. Anyone with a vertical cup:disc ratio (VCDR) of ≥ 0.6 was referred to the ophthalmologist (MA) for detailed examination. This VCDR was selected as data from the Nigeria national survey of blindness where a VCDR of 0.7 was identified as the cut-off for defining level 1 evidence of structural disc damage due to glaucoma [11]. Examination included presenting and unaided distance visual acuity (VA) measured

in each eye by an ophthalmic nurse using a Snellen E chart. Best corrected VA was assessed using readings from an autorefractor (Takagi, Japan); the swinging flashlight test was performed for relative afferent pupillary defects, and anterior segments were examined at the slit-lamp (CSO, Italy). Other assessments included Von Herrick's peripheral anterior chamber depth, IOP measurement (Goldman applanation tonometry), gonioscopy where possible, and optic disc examination using a 60D lens to assess VCDR, cup disc asymmetry and the presence of splinter haemorrhages or a notch. If slit lamp disc assessment was not possible, discs were examined by dilated binocular indirect ophthalmoscopy. Automated perimetry was performed using the screening program of the Oculus Twinfield visual field analyser (VFA) followed by threshold testing if defects consistent with glaucoma were detected. The diagnosis of POAG was made using internationally accepted guidelines [12] based on VCDR, visual field defect (VFD), IOP and an open angle on gonioscopy. Those confirmed with glaucoma who were eligible were recruited after taking written informed consent.

Glaucoma was graded by eye, and then by person using the worst affected eye. The following definitions were used: end stage: VA hand movement or worse and VCDR of 1.0; advanced: central VF of $<10^\circ$ or VA $< 3/60$ in the presence of VCDR >0.8 ; moderate: central VF $10-20^\circ$ with VCDR >0.7 with any level of VA; mild: any other glaucomatous VFD and a VCDR >0.7 . A VCDR of >0.7 was used as this defined the 95th percentile in the Nigeria national survey normative dataset [11]. In our study advanced and end stage disease both fulfil WHO VA and VF categories of blindness.

The following information was obtained by interview: age, sex, literacy, occupation, distance from residence to the hospital, family history of visual loss or glaucoma, whether they knew they had glaucoma and if so, when and where it was diagnosed and previous treatment. Participants were asked what they knew about glaucoma and its treatment, and responses were graded using a four-point scale ranging from poor (i.e. they had never heard of glaucoma) through to excellent (i.e. they knew it is associated with high IOP or causes optic nerve damage or VFD). Knowledge of treatment was categorized as poor if they knew nothing about it through to excellent if they knew that glaucoma is treatable and could name a treatment.

Participants were offered treatment after explaining the condition and treatment options, taking account of the stage of disease, other clinical parameters and socioeconomic factors. Whether they agreed to the treatment recommended was recorded as well as reasons for not agreeing. Participants agreeing to surgery were started on topical treatment and given a date within two months to attend for surgery. Those recommended topical treatment were asked to re-attend in one month for IOP measurement and to assess adherence to medication. Adherence was assessed verbally and categorised as excellent if they had only missed very few doses, average, or very poor if they took only few to no doses.

Ethical approval was obtained from the ethical and research committees at London School of Hygiene & Tropical Medicine and ATBUTH. This study adhered to the tenets of the declaration of Helsinki.

Data analysis

Data were entered and analysed using Stata 11.2 StataCorp LP. The eye with the most advanced glaucoma was used in the analysis for comparison with other studies. Data were analysed using two levels of severity: end-stage plus advanced, and mild plus moderate glaucoma. Age was categorized as ≥ 50 years and < 50 years. Univariate and multivariate analyses were undertaken to assess associations between stage of disease and mode of presentation, age, sex, ethnicity, distance to place of residence, literacy, occupation and family history of glaucoma.

Results

During the study (May-Sept 2010) 6,291 patients attended the outpatient department, 1,692 of whom were aged ≥ 30 years. 209 individuals were examined by the ophthalmologist based on a VCDR ≥ 0.6 in one or both eyes, 131 of whom were diagnosed with POAG i.e. 7.9 % (131/1692) of adult clinic attendants. The mean age of the 131 participants was 52.8 years (range 30-87 years), 62 % were male and 111 (90 %) had bilateral glaucoma (Table 2).

Mode of presentation

Most participants attended because of symptoms ($n = 92$, 70 %), 18 (15 %) were formally referred with a diagnosis of glaucoma, 10 (8 %) were identified by the optometrists as they had a VCDR of ≥ 0.6 , and 11 (8 %) were first-degree relatives of individuals with POAG who attended for assessment. Fifteen of the 18 referrals (14 % overall) were already receiving treatment as were 43/92 (33 % overall) presenting with symptoms. Sixty one participants therefore had a previous diagnosis of glaucoma, and 70 were newly diagnosed.

Clinical findings at presentation

Visual field testing was not possible in 73 (56 %) participants on account of loss of fixation or poor comprehension or manual dexterity. Intraocular pressures in all eyes with POAG ranged from 10 – 68mmHg (mean 31.9 \pm SD 12.4). The mean IOP of eyes already on treatment was lower than those not being treated (27.3mmHg, range 10-55mmHg versus 32.1mmHg, range 12-68mmHg). Mean VCDR in all eyes with POAG was 0.8 and 44 % of eyes had a VCDR of 1.0 (Fig. 1). 99 eyes (47 %) had a presenting VA of light perception or no light perception. 46 individuals (35 %) were blind in their better seeing eye (presenting VA $< 3/60$). Overall 100 (76 %) participants were blind from glaucoma using WHO criteria i.e. had end stage or advanced glaucoma.

Forty-seven participants (36 %) had a positive history of blindness in their family, 29 of whom (22 %) gave a definite family history of glaucoma. The majority of patients (83 %) had poor awareness about glaucoma and how it is treated.

Risk factors for advanced or end stage disease

In univariate analysis the following were associated with advanced or end stage disease in the worse eye: age > 50 years, living > 10 km from the hospital, some awareness of glaucoma, not being literate, being unemployed or a housewife and presenting with symptoms (Table 3). In multivariable analysis age and poor knowledge of glaucoma were independent risk factors for late presentation. Participants living more than 10km from the hospital were 2.94 times more likely have advanced/end-stage disease but this did not reach statistical significance (OR 2.94, 95 % confidence interval (CI) 0.93-9.32, $p = 0.067$). Living in urban areas (OR 0.35 95 % CI 0.11-1.07, $p = 0.067$) was protective in univariate analysis but this did not reach statistical significance. Findings were similar for least affected eyes (data not shown).

Acceptance of surgery and adherence to medical treatment and follow up

Forty six participants were offered treatment for pain control for end stage disease and 85 were offered treatment to

Table 2 Characteristics participants with POAG, by stage of glaucoma at presentation in the most affected eye

		Mild/Moderate		Advanced/End stage		Total	
		N	%	N	%	N	%
Mode of presentation	Symptomatic	15	16	77	84	92	100
	Referred	7	39	11	61	18	100
	Opportunistic	6	60	4	40	10	100
	First degree relative	3	27	8	73	11	100
Gender	Male	19	23	62	76	81	100
	Female	12	24	38	76	50	100
Age	50 years and above	10	13	70	87	80	100
	Less than 50 years	21	41	30	59	51	100
Ethnic group	Hausa	12	20	48	80	60	100
	Other	19	26	52	73	71	100
Occupation	Professional/civil servant/student/soldier/other	16	31	35	69	51	100
	Traders/Artisans/farmers	12	24	37	76	49	100
	Housewife/unemployed	3	10	28	90	31	100
Literacy	Not literate	10	13	65	87	75	100
	Literate	21	37	35	63	56	100
Family history of glaucoma	Yes	10	34	19	66	29	100
	No	21	21	81	79	102	100
Residence	Urban	27	28	70	72	97	100
	Rural	4	12	30	88	34	100
Place of residence	Within 10 kms of hospital	25	30	56	70	81	100
	10kms or more	6	12	44	88	50	100
Awareness of having glaucoma	No	19	23	63	76	82	100
	Yes	12	24	37	75	49	100
Knowledge about glaucoma	Good	11	50	11	50	22	100
	Poor	20	18	89	82	109	100
	Total	31	24	100	76	131	100

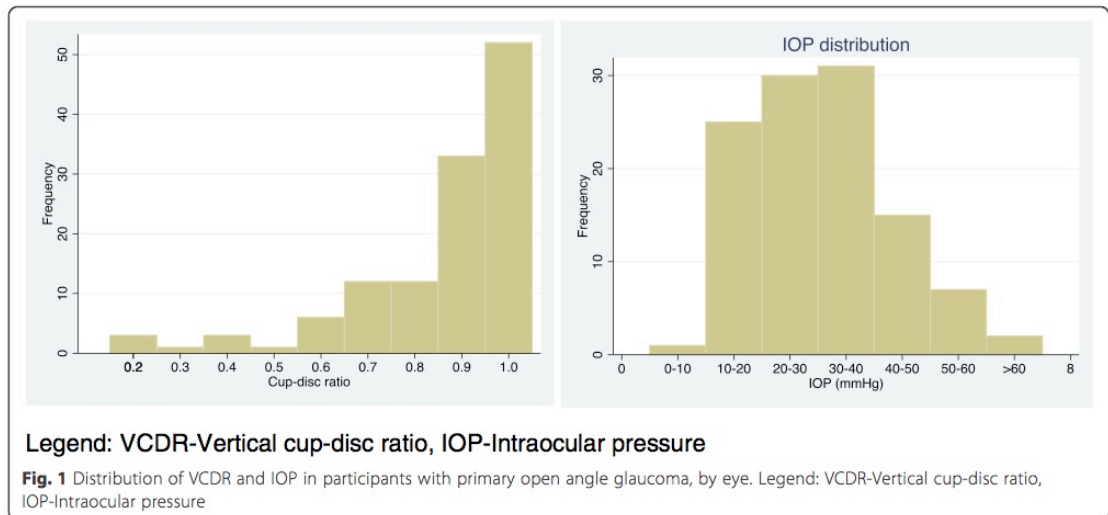


Table 3 Univariate and multivariable analysis of factors associated with advanced or end stage glaucoma at presentation, using the most affected eye

		Univariate analysis			Multivariable analysis		
		OR	95 % CI	P value	OR	95 % CI	P value
Sex	Male	1.0			1.0		
	Female	0.97	0.42-2.22	0.942	0.85	0.25-2.92	0.795
Age	Less than 50 years	1.0			1.0		
	>50 years	4.9	2.06-11.65	<0.001	3.45	1.24-9.58	0.017
Family history of glaucoma	Positive	1.0			1.0		
	Negative	0.53	0.21-1.29	0.16	0.39	0.12-1.28	0.122
Distance to hospital	10 km or less	1.0			1.0		
	More than 10km	3.27	1.24-8.67	0.017	2.74	0.75-10.09	0.129
Knowledge about glaucoma	Poor	1.0			1.0		
	Good	0.22	0.08-0.59	0.002	0.27	0.80-0.92	0.036
Literacy	Literate	1.0			1.0		
	Not literate	3.9	1.65-9.19	0.002	2.19	0.69-6.92	0.180
Awareness of having glaucoma	Yes	1.0					
	No	1.07	0.46-2.46	0.864			NS
Ethnicity	Hausa	1.0					
	Other	0.80	0.52-1.24	0.327			NS
Occupation	Professional/civil servants etc.	1.0					
	Traders/Artisans/farmers	1.40	0.58-3.39	0.301			NS
	Housewife/unemployed	4.27	1.12-16.12	0.032			NS
Mode of presentation	Referred	1.0					
	Symptomatic	3.26	1.09-9.78	0.034			NS
	Opportunistic	0.42	0.87-2.06	0.288			NS
	First degree relative	1.69	0.33-8.67	0.525			NS
Residence	Rural	1.0					
	Urban	0.35	0.11-1.07	0.067	0.65	0.15-2.79	0.56

OR = odds ratio; 95 % CI = 95 % confidence interval; NS = not statistically significant

preserve visual function. Among the latter, 14 were offered topical treatment and 71 were offered trabeculectomy as the treatment of choice. Only five (8 %) agreed to surgery. Reasons for not accepting surgery included fear (37 %), wanting to continue current treatment (27 %), cost (15 %), no time (6 %), being too old (4 %) or needed to consult their family (4 %). Only one patient returned for trabeculectomy. Among the 85 participants started on topical medication, 32 (24 %) returned at one month. 72 % reported excellent compliance but only 56 % of glaucomatous eyes had an IOP of <21mmHg.

Discussion

The majority of patients in this study presented to hospital because of symptoms, with many already blind in at least one eye, which confirms the findings of other studies in Africa. Our series of patients were far more likely to be blind at presentation than cases who present to eye departments where there are primary care providers such as

optometrists, who can detect and refer individuals suspected as having glaucoma. For example, in a study from the UK, 91 % of eyes had a visual acuity of 6/12 or better at presentation [13].

In this study 38 % of patients were not aware they had glaucoma before the study and only 17 % had any knowledge about glaucoma, being similar to a study in Ethiopia, [14] and many population based studies in other parts of Africa and other regions of the world, including industrialized countries [15–17]. The finding that some patients already being treated for glaucoma had poor knowledge of the condition reflects poor counselling, which is a challenge in northern Nigeria as there is not a local word in the Hausa language for glaucoma. Lack of knowledge of glaucoma is greater amongst people with low socioeconomic status [18] who need to be targeted for interventions, as greater knowledge of glaucoma has been associated with greater adherence to treatment, in Oman for example

[19]. Indeed, poor knowledge has also been reported among eye health workers [20].

In this study older age and poor knowledge of glaucoma were independent risk factors for late presentation in multivariable analysis. Living more than 10km from the hospital increased the risk in univariate analysis, as did not being literate, presenting with symptoms and being unemployed. These associations did not reach statistical significance in multivariable analysis, possibly reflecting the relatively small sample size. Other studies in Africa have shown a relationship between late presentation of POAG with low levels of education and low socioeconomic status, [21] but these factors were not independent risk factors in our study. Greater awareness needs to be created about glaucoma in the population to promote earlier presentation.

Acceptance of surgical treatment for glaucoma is a problem in Africa, [5, 6, 22] as was confirmed in this study. In Tanzania, individuals identified with glaucoma during a population-based survey were referred for trabeculectomy. Acceptance of trabeculectomy was 46 % lower than cataract surgery (80 %) but nevertheless high for glaucoma in Africa. Many patients in Africa do not understand why they are offered surgery in the better eye, particularly if they are already blind in the other eye. In addition, the Hausa word for surgery, which translates as butchering, has very negative connotations. Acceptance of eye surgery is also poor for other eye conditions e.g., for trichiasis surgery [23] and rumours can play a role in patient's decision making [24].

A trial in India demonstrated that acceptance of treatment increased with education [25]. Implications are that counselling or health education, which dispels rumours and overcomes fear can improve acceptance of treatment. Counselling techniques such as Motivational Interviewing, shown to be promising in a range of conditions [26–28], could play a role. The aim of Motivational Interviewing is to explore and resolve patient's ambivalence and promote his or her own motivation for change. This hypothesis is currently being explored in a randomised trial of surgical interventions for glaucoma in ATBUTH, Bauchi [29].

Adherence is defined by WHO as “the extent to which a person's behaviour corresponds with agreed recommendations from a health care provider” [30]. Self-reported adherence in this study was relatively high at 72 %, but as this did not correspond with IOP reduction this finding is questionable. Adherence to treatment is a global problem. Indeed, a National Health Service (United Kingdom) report estimated that 30–50 % of prescribed medication is not taken as recommended [31], and a study in the United States of America showed that nearly half of patients on ocular hypotensive therapy discontinued within six months [32]. Non-compliance with glaucoma treatment is common but more common in patients of African descent

[33]. Motivational interviewing may also have a role to play in increasing adherence to topical medication for glaucoma in Africa and other settings.

In our study only a quarter of patients attended follow up at one month, which was lower than reported in Ibadan, Nigeria [34]. In our study reasons for non-attendance were not investigated but in the Ibadan study reasons included lack of transport, fear of surgery, no improvement with treatment, feeling better or no improvement with treatment. Similar findings have been reported from India [35]. In the Ibadan study default was more likely among younger patients, males and those from long distances while those with severe disease were more likely to attend. Poor follow up after surgery has also been reported in Tanzania, for example [22]. Poor knowledge has also been linked to poor follow up among glaucoma patients [36].

The implications of our study are that counselling is needed at the time of diagnosis so that patients understand the purpose and importance of follow up. Our study supports the recommendation of others of the need for a once off treatment for glaucoma in Africa that does not require regular follow up [5, 37].

This study demonstrates some of the problems encountered in managing glaucoma in Africa. Strategies which promote earlier detection, such as opportunistic screening or examination of first degree relatives, coupled with counselling, may promote greater acceptance and adherence to treatment. Public awareness needs to be increased while services and expertise are being developed, which needs to include a once-off, relatively non-invasive treatment of proven effectiveness which is acceptable to patients, such as laser trabeculoplasty or transscleral diode laser cyclophotocoagulation.

In Africa, until glaucoma care becomes a sub-speciality supported by technology for assessment, grading will need to rely primarily on estimation of VCDR and VA, supported by VF assessment when possible, with the goal of avoiding bilateral blindness. This is supported by our study where only 36 % of patients were able to perform VF testing well enough to allow glaucoma to be diagnosed based on characteristic VFDs.

Strengths of this study are that it was a single centre, prospective study, and one ophthalmologist undertook all diagnostic examinations. Limitations include the relatively small sample size and the diagnosis of glaucoma was based mainly on VCDR and IOP as VF testing was not possible in many participants.

Conclusion

Majority of glaucoma patients in Africa only report to hospital when they have symptoms of loss of vision. This late presentation coupled with poor adherence to medical treatment and acceptance of surgery means that many

continue to go blind despite reporting to hospital. To prevent glaucoma blindness strategies are required which promote earlier detection, with counselling to promote acceptance of and adherence to treatment.

Abbreviations

ATBUTH: Abubakar Tafawa Balewa University Teaching Hospital; CI: Confidence Interval; IOP: Intraocular Pressure; Km: Kilometre; NS: Not significant; OR: Odds ratio; POAG: Primary Open Angle Glaucoma; SD: Standard deviation; VA: Visual acuity; VF: Visual field; VFA: Visual field analysis; VFD: Visual field defect; VCDR: Vertical cup-disc ratio; WHO: World Health Organisation.

Competing interests

The authors declare that they have no competing interests.

Authors contribution

MA: Research design, data acquisition, data analysis and interpretation, and manuscript preparation. CG: Research design, data analysis and interpretation and manuscript preparation. JE: Data analysis and interpretation, and manuscript preparation. All authors read and approved the final manuscript.

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Health education for glaucoma –rationale for using Motivational Interviewing

Health literacy - the degree to which individuals have the capacity to obtain, process, and understand basic health information and services needed to make appropriate health decisions, [168] has been associated with progression of visual field loss in glaucoma patients. For example, in a study in the UK, patients with poor health literacy had poorer compliance, worse understanding of glaucoma, and the condition was more likely to progress compared with those with adequate health literacy. This highlights the need to promote health literacy in patients with glaucoma.[169]

A review of health promotion and the prevention of blindness in developing countries demonstrated three key components of effective health promotion: health education should be directed at behaviour change to promote the adoption of healthy behaviour and to increase uptake of eye care services using an appropriate method of delivery such as mass media, face-to-face discussion or social marketing. This includes identification of barriers, a suitable setting and approaches that are acceptable and delivered by appropriately trained individuals. The second element is improvement in health services in terms of quantity and quality by addressing locally identified barriers, improving quality of information provided to patients to promote adherence to treatment and follow up. It is also important to improve other non-clinical aspects of care to make the services more accessible, affordable, effective and acceptable. The third component is advocacy to improve awareness of the importance of blindness prevention among policy makers and planners to increase resource allocation for eye care and influence implementation of these policies. The review also showed instances where health education had impact on blindness prevention efforts at various levels.[170]

Research has demonstrated the benefit of health education in improving glaucoma awareness and uptake of services. For example, mass education in the United States reduced glaucoma blindness through influencing individuals at risk, such as people of African descent, to participate in regular ophthalmic care.[171] Similar findings were reported in a clinical trial in India of a counselling education package delivered by a paramedical worker. In this trial 65% of patients in the intervention arm accepted early compared with 35% in the usual care arm. The study also showed that early surgery offers better IOP control than medical treatment.[67]

An important aspect of health education is mode of delivery. In the United States, focused video instruction was an effective and efficient teaching intervention for disseminating health information in the waiting area of a clinic.[172] In the Netherlands, patients preferred the ophthalmologist, the nurse or a representative of the glaucoma patient society to provide health education.[173] In Shanghai, China, glaucoma clubs seemed to play a role in increasing patient's awareness and knowledge about glaucoma, thus increasing compliance with medication.[174] In a specialist eye hospital in England patients benefitted from education programs on beliefs and compliance in glaucoma and ophthalmic nurses were effective teachers.[175] In Barbados, obtaining eye care from the single public ophthalmologic source was associated with an 80% reduction in the odds of poor awareness.[176]

Knowledge of glaucoma in Nigeria is poor not just among patients, but also among health workers. [177] In a cross sectional survey of a population of 40 years or above in people attending ophthalmic outreach in Ethiopia, only 8/340 people (2.4%) were aware of glaucoma.[174, 178] In another study in India, only 8.7% had some knowledge of glaucoma.[179] Poor knowledge in a US study has also been linked to poor follow up among glaucoma patients.[180]

Fear has been a recurring reason for not accepting surgery whether for cataract or for glaucoma. For example, in the Collaborative Initial Glaucoma Treatment younger age, being white, and having less education and a lower income were associated with greater fear of blindness.[181] Using fear as a counselling strategy could be a double edged sword, however: on one hand fear of blindness could be a source of motivation for improving adherence to medication[182] while on the other hand fear is known to be a disincentive to accepting surgery.[84]

Conceptual framework

Efforts to improve health by increasing patient knowledge alone have rarely been successful. Two important models of patient education have been broadly described. These are the **information dissemination model** and the **behaviour change model**.^[183]

The information dissemination model involves information dissemination to patients using teaching, printed materials or multimedia such as videos and audio programs. This is the most commonly used system in patient education. Outcomes have been varied, successful in some instances, as outlined above, or failure as in a study of patients with hypertension where increase in knowledge did not affect adherence to medication or control of blood pressure over time.^[184]

The behaviour change model uses the behavioural diagnosis concept as the hallmark of patient education. This model identifies variables that positively or negatively influence the patient's decision towards the desired behaviour. Behaviourally oriented programs, often with special attention to changing the environment in which patients care for themselves, have been consistently more successful at improving the clinical course of chronic disease.^[185] Patient education should, therefore, ideally achieve a change in behaviour. A good example of behaviour change model in clinical use is the health belief model (HBM). The health belief model is one of the health promotion theories that are applied at the individual level. It can be used to illustrate the behaviour change that is needed to improve the clinical course of chronic diseases such as glaucoma or encouraging reluctant patients to accept care.^[186] The model was developed initially in the USA to understand the widespread failure of people to accept interventions for disease prevention, such as screening tests for the early detection of asymptomatic disease.^[187] Components of the HBM are perceived susceptibility, perceived seriousness, perceived benefits, perceived barriers and cues to action (Figure 2). These can all be applied to glaucoma.

Perceived susceptibility: i.e., the individual's perceived chance of getting the disease.

This is likely to be very low in Africa

Perceived seriousness: i.e., a self-judgment of the seriousness of glaucoma as a disease.

This too will be low unless a family member or someone known to them has visual loss from glaucoma in which case the perceived seriousness is likely to be high.

Perceived benefit: i.e., the person's belief about the importance of presenting early for treatment or accepting surgery for glaucoma.

Perceived barriers: i.e., factors that militate against the pursuit of the required behaviour change outlined. This may be affected by many factors such as fear of the procedure or embarrassment of being thought blind.

Cues to action: i.e., modifying factors that reinforce the threat level which lead to behaviour change.

The perceived susceptibility and seriousness can increase the perception of the threat that glaucoma poses to the individual, which can, with cues to action, lead to the desired behaviour change.

Modifying factors: In the HMB the modifying variables are demographic factors (age, sex, race and ethnicity), socio psychological factors (personality, social class, culture, education and peer group pressure) and structural variables (knowledge of or contact with the disease). These factors interact in a complex relationship to lead to likelihood of action to change or modify behaviour.

Self-efficacy is the person's belief in their ability to execute the behaviour change, in this case early presentation, acceptance of and adherence to treatment and follow up. This can also be affected by many of the modifying factors above. Barriers for control are the major challenges posed by glaucoma in Africa, which are: 1. disease factors such as early onset of glaucoma and [4] aggressive course,[102] higher prevalence,[24] surgical failure,[70] even with mitomycin C[69] and β radiation[71] and medical treatment failure[188]; 2. provider factors which include poor facilities and equipment,[189] lack of adequate skills[190] and limited treatment options; and 2; patient factors which include poor awareness,[191-193] fear and cost of treatment[84, 86, 154] and late presentation.[160]

Despite there being little conceptual overlap between MI and the HBM, the HBM was used as a framework in order to integrate educational awareness raising elements (e.g. susceptibility and seriousness in HBM terms) with more motivational ones (benefits and barriers) which are potentially modifiable by MI.

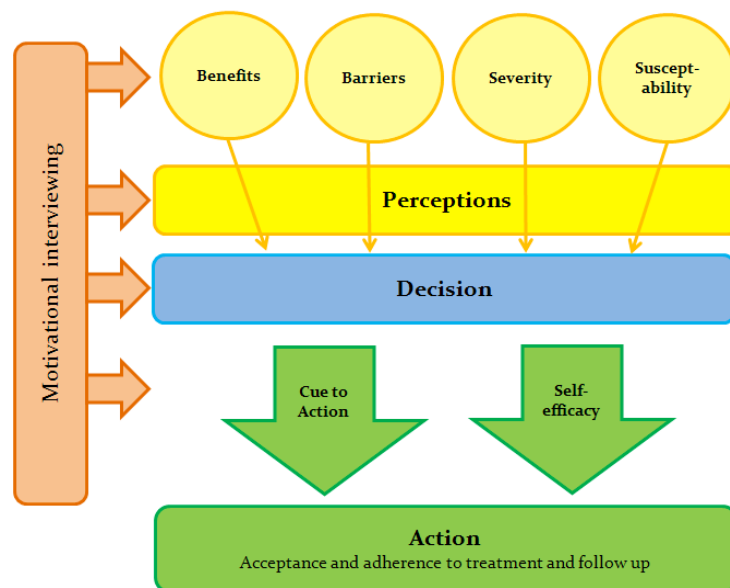


Figure 3: Health Belief Model in relation to glaucoma and potential of motivational interviewing.¹

Challenges in health education

In Nigeria there is no term for glaucoma, IOP or visual field defects in the local language, and a high proportion of the population in Northern Nigeria are not literate. In order to educate patients, a simple means of disseminating useful, easily understood information on glaucoma and its management had to be designed.

In this study the important barriers for control, more specifically early presentation, acceptance of treatment, adherence to medication and follow up were identified. Armed with this knowledge an educational package was created and a suitable mode of presentation that is simple, easily taught and replicable was found. By consultation with experts in LSHTM, Motivational Interviewing was suggested as suitable delivery method that fits the criteria and has been tried in similar circumstances and been found to be effective.

¹ Adapted and modified from: <https://www.scienceandsensibility.org/blog/perception-is-everything-understanding-the-health-belief-model>

What patients know about glaucoma

Glaucoma is a very difficult concept to explain to the ordinary patient attending our clinic and patients often have no understanding of what it means. Patients obtain different explanations about the disease from different sources. Most of the terms used are descriptive of the pattern of visual loss or the symptoms that the patients experience. In order to create an easily understandable counselling guide for glaucoma, it was necessary to understand what the patients think about the disease. To do this a series of focus group discussions and in-depth interviews were carried out with new patients, old patients, carers of such patients, patients who were blind from the disease, patients who had undergone surgical treatment, and those who refused surgical treatment. As many patients consult traditional healers before coming to the hospital, it was also necessary to discuss with the traditional healers to find out what they know about glaucoma, what treatment they offer and what they say to patients. Information obtained from these sources was used to phrase the counselling intervention to fit patients' current understanding of the disease.

The following paper describes what patients know about glaucoma and their general attitude in the management of the disease.

1. Glaucoma, "the silent thief of sight": patients' perspectives and health seeking behaviour in Bauchi, northern Nigeria. Abdull MM, Chandler C, Gilbert C.. BMC Ophthalmology. 2016;16(1):1-9.

Paper 5. Glaucoma, “the silent thief of sight”: patients’ perspectives and health seeking behaviour in Bauchi, northern Nigeria

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Student	Mohammed M Abdull
Principal Supervisor	Clare Gilbert
Thesis Title	Adapted motivational interviewing to improve uptake of treatment in glaucoma patients in Bauchi state, Nigeria

If the Research Paper has previously been published please complete Section B, if not please move to Section C

SECTION B – Paper already published

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RESEARCH ARTICLE

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Glaucoma, “the silent thief of sight”: patients’ perspectives and health seeking behaviour in Bauchi, northern Nigeria

Mohammed Mahdi Abdull^{1,3*}, Clare Chandler² and Clare Gilbert³

Abstract

Background: In Nigeria, glaucoma has a high prevalence and is the second cause of blindness among adults after cataract. People with glaucoma frequently present very late with advanced disease, and acceptance of and adherence to treatment is low. The purpose of the study was to explore how patients’ understand and respond to glaucoma in order develop an intervention to improve adherence to treatment.

Method: Hospital based qualitative study. Six focus group discussions were held with patients with advanced disease and who had either undergone glaucoma surgery, were receiving medical treatment, or had neither surgery nor medical treatment. Two traditional healers who treat eye conditions were interviewed. Audio files were transcribed, translated into English and recurring themes coded and categorized as the impact of vision loss, and understandings of the disease and its management.

Results: Visual loss impacted significantly on the lives of people with glaucoma in many ways. Many heard the term “glaucoma” for the first time during the study. Local terms to describe the symptoms included *Hawan jinin ido* (“hypertension of the eye”). Patients sought treatment in pharmacies, or with traditional healers who had different interpretations of glaucoma and its treatment to biomedical understandings. Cost and forgetfulness were the main reasons for low adherence to treatment while fear was a reason for not accepting surgery. Lack of money and negative staff attitudes were reasons for low follow up.

Conclusion: Halting the progression of glaucoma is possible with treatment but the condition will remain a “silent thief of sight” in West Africa unless awareness, uptake of services and adherence to treatment improve. Understanding how glaucoma is locally conceptualised, lived with and responded to by patients is essential to aid the design of interventions to prevent glaucoma blindness in Africa. Findings have been used to adapt a motivational interviewing intervention, which is being evaluated in a clinical trial.

Keywords: Glaucoma, Behaviour, Adherence, Treatment, Africa, Awareness, Acceptance, Traditional medicine

Background

Glaucoma is the second commonest cause of blindness worldwide after cataract [1] and is the leading cause of irreversible blindness. In Nigeria, over one million people are estimated to be blind (0.78 % of the population), with 16.3 % attributed to glaucoma [2]. Together with its high prevalence, glaucoma in Africa

is characterised by an early age of onset and aggressive disease course [3]. Early presentation and treatment are essential to reduce the incidence of blindness. However, studies in Africa show that a high proportion of affected individuals only present once they are already blind in one or both eyes [3–10]. Once diagnosed, adherence to medical treatment is reported to be low [11] with high dropout rates [12, 13]. Surgical treatment is often not accepted or fails to control progression [11, 14, 15].

Understanding the way the symptoms and diagnosis of glaucoma are conceptualised lived with and responded

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to is essential to guide the design of interventions to increase early attendance for diagnosis and acceptance of treatment. Studies from around the world have identified the problem of low adherence or drop out from glaucoma treatment [16–19], being associated with poor knowledge of glaucoma [20–24], low levels of education [25, 26], black ethnicity [12, 27–31], worsening visual field loss [32], increasing age [28, 33, 34], lack of access to medication, inability to instil eye drops and forgetting to use the treatment [35–38]. Few studies have investigated this in African populations, although low awareness of the disease [39, 40], and fear and cost of treatment have been reported [41]. A diagnosis of glaucoma is often the first time a layperson encounters the disease [42–46].

The purpose of this study was to explore how patients understand and respond to glaucoma in Bauchi, north-east Nigeria: what they know about the disease, how they conceptualise its treatment and how they manage it, the family support and alternative sources of treatment. Traditional healers were interviewed to triangulate patients' responses.

The study was undertaken in the eye clinic of Abubakar Tafawa Balewa University Teaching Hospital (ATBUTH) in Bauchi. The population are mainly subsistence farmers and levels of education are low. 70 % of the population live below the poverty line [47]. The catchment area of the hospital is approximately 4 million. Eye care is also provided in the State by another government hospital and a private mission clinic. Most expenses are covered by out of pocket payments by patients. Some government and private company workers have access to health insurance. Many people, particularly in rural areas, rely on traditional healers, who are mostly herbalists.

Methods

Focus group discussions (FGDs) were undertaken with glaucoma patients identified in the eye department at ATBUTH. Traditional healers who treat patients with eye problems were also interviewed to elicit additional insights into patient perceptions and management of glaucoma. Topic guides were developed and used with probe questions to aid discussion as necessary.

Participants

Six FGDs were undertaken. Three sub-groups of patients with late glaucoma in at least one eye were recruited: those who had undergone surgery, those on medication and those currently not on treatment, (Table 1). Late disease was defined as a visual acuity of less than counting fingers in at least one eye due to glaucoma. Eligible glaucoma patients were identified in the outpatient department using standard clinical methods. Further inclusion criteria included being resident in the state for at least 6 months, an ability to understand Hausa or English and willingness to participate. Separate FGDs were held with men and women to encourage open responses rather than to elicit gender differences. Escorts of the same gender were permitted to attend. Patients understood that their responses would be used for intervention design and completion of academic studies by the researcher. The FGDs took place in a quiet room in the hospital and each FGD comprised 7–11 patients and 1–3 escorts, and discussions typically lasted for 1–2 hours. Two traditional healers, who were identified by asking patients who they had visited, were interviewed in their homes, which also doubled as their places of work. Interviews and FGDs were conducted by a female social scientist experienced in counselling and interviews. Discussions were audio recorded with permission from the group. A note taker recorded additional observations. The lead investigator (MA, a male) was present only during interviews with the traditional healers who were both male.

Data management

All records from discussions and interviews, including written notes, audio files and summaries of each event were linked by unique identifiers and stored securely. Audio files were transcribed verbatim into Hausa and proofread against the audio file by both the interviewer and the lead researcher for accuracy. Transcripts were then translated from Hausa into English and rechecked by the researcher (MA). A meaning-based translation approach was used: where there was no terminology for a word in English it remained in Hausa. All audio files, transcripts, translations and summary notes were uploaded

Table 1 Glaucoma patient study sub-groups and topics

Sub-group	Topics of particular interest
Late glaucoma patients who had undergone surgery	To gain insights into what motivated them to accept surgery. What their fears were prior to their decision and how they overcame them.
Late glaucoma patients who were on medication	To explore the motivation behind their reported adherence to medication while facing a real threat to their vision. To explore coping techniques used to ensure availability of their drugs and adherence. To explore if they were ever offered surgery to find out why they did not accept it.
Late glaucoma patients who had not undergone surgery and were not on medication	To explore reasons for presenting very late to hospital, accepted surgery or medication. To try to understand the barriers they could not overcome.

into Nvivo for coding and analysis. The analysis was undertaken using the Hausa transcript by the researcher who is bilingual in Hausa and English. Relevant sections of transcripts and observers' notes were used in the analysis to explore recurring themes, which were coded in NVivo software (QSR International). These were categorized by the researcher in consultation with the interviewer as an ongoing process through the fieldwork, according to the topics of interest i.e. understanding of glaucoma, adherence to medication, their views on traditional healers, acceptance of surgery and follow up, family support and problems faced because of glaucoma. The analysis followed a meaning-based approach, whereby themes were seen as emergent from the interaction between researchers, their questions and research subjects. Only themes considered strongly represented in the data are presented. Samples of the interviews were read by CC and CG in order to converge on the most salient themes to answer the research questions. Relevant quotes presented in this paper were extracted from the English translation.

Results

Sixty-six patients participated, approximately half of whom were male. Approximately a fifth were escorts who were usually close relatives or spouses who live with and care for the patients. Many patients were happy to talk about their condition and it seemed important to them that someone cared enough to listen. None refused invitation to participate and participants were not invited back to provide feedback on the findings.

Understanding of glaucoma

Despite having late stage disease, many said they heard the term "glaucoma" for the first time during this study. Those familiar with the term had heard it from hospital staff after diagnosis. However, people were familiar with the symptoms, but not universally.

The peripheral field loss characteristic of glaucoma was graphically described by some, as *Taka shanya* which describes stumbling when walking looking straight ahead and *Ciwon dundumi* which means "groping illness", a common term in areas where onchocerciasis ("river blindness") is endemic. Some used more general terms such as *Hazon ido*, which means cloudy vision, and *Yanar ido*, which is commonly used to describe cataract. Some attributed the symptoms to *Hawan jinin ido*, which literally means hypertension of the eye, or *Amosanin kai*, which means dandruff of the scalp.

Given the multiple local constructs relating to the single biomedical category of glaucoma, it is not surprising that multiple causes of these symptoms were reported.

"It is caused by high blood pressure". FGD 01-M52

"Bleeding in the eye as a result of accident can bring about glaucoma". FGD 02-F52

"Being possessed by evil spirits which attack the eye". FGD 05-M33

"Apollo infection can turn into glaucoma". FGD 03-M43

Apollo is a local name for a highly infectious form of viral keratoconjunctivitis, which occurs in epidemics in West Africa. Other causes included eating processed food, exposure to cold, prolonged crying/mourning, and frequent exposure to smoke from fires. However, many respondents admitted that they did not know what causes this eye condition.

Perceived threats because of blindness

Visual loss from glaucoma leads to disruption in everyday life and can have a major impact on activities, social standing and aspirations, which were described vividly by some. Table 2 describes the impact of blindness from glaucoma according to Khadka, and adherence to treatment regrouped according to Newman-Casey [48, 49].

Coping with loss of vision was a major issue. Some were able to cope with family support while others harboured resentment. Loss of job, self esteem or profession were major issues. A young man had this to say.

"This sickness has affected our ambition and killed our dreams". FGD 06-M47

Glaucoma patients described different forms of support from family and friends, and some spoke of the burden their condition placed upon these carers. Sometimes the responses of others were not supportive:

"My neighbour was happy I was on my way to blindness". FGD 06-F56

Seeking treatment

Patients sought treatment in a variety of places. Some went to pharmacies to purchase eye drops or seek advice about treatment while others consulted friends or neighbours. Some respondents described visiting traditional healers before coming to the hospital and there were a range of responses (Table 2).

"Traditional medicine is trial and error". FGD 04-M31

"It is possible to get cure from traditional herbs because most of the modern medicine we use are processed from traditional herbs". FGD 03-M52

In-depth interviews with traditional healers

Traditional healers were often visited first by patients before attending hospital while others visited healers as a last resort.

Table 2 Examples of participant responses on specific topics about glaucoma

Impact of glaucoma and blindness from glaucoma
Emotional well-being
"This sickness has affected our ambition and killed our dreams". FGD 06-M47
"As human nature, relatives, friends and neighbours sometimes avoid us. In fact the relationship is not the same again". FGD 03-M62
"Our relatives are trying their best but sometimes they get tired". FGD 06-F69
"I wanted to study so much but I got this disease at secondary school. I am not happy about it since I was one of the best students in school. I still dream about school". FGD 02-F40
Social issues
"This sickness has also affected our roles and the status we occupy at home and in society generally". FGD 06-M47
"The sickness affects our social activities. For example, we cannot attend some social gatherings". FGD 06-F50
Economic issues
"I cannot do the work I used to do before the onset of this sickness". FGD 03-M30
"I am a professional and I cannot do my job now. I used to farm very well but now I cannot do it. Lack of sight has deprived me of many things". FGD 03-M51
Resilience
"When one is blind, he/she just has to tolerate and bear certain things". FGD 01-F22
Impact on family and relationships
"Relations show concern and care to our sickness". FGD 01-F40
"My sickness affects every activity my relatives are engaged in. For example they have left their farms, business, work and little ones alone just to be with us here in the hospital". FGD 04-F50
"Family and relatives help us in most of our chores, but they may not do everything the way we want it done". FGD 04-F52
Seeking treatment
"My neighbour prescribed my eye drop for me when I told him I have glaucoma because he also has the same illness. FGD 01-M57
"I don't think glaucoma or any other eye problem has traditional cure. This is because traditional healers don't have equipment to test any eye disease". FGD 04-M26
"I once use traditional herb, but there was no improvement"
"Traditional healers use one herb to treat many different ailments, so they can be very dangerous". FGD 01-F45
"I once met a traditional leader who told me my problem was glaucoma. He wanted to operate on my eye but my colleagues warned me and said if the surgery does not work, where will you see the man to complain or sue him in the court when my eyes go blind? So I opted out and refused the operation" FGD 05-M32.
Adherence to treatment
Forgetfulness
"We try our best to use the drugs as prescribed, but it is natural as human beings to forget once in a while". FGD 03-F35
Beliefs about medication / side effects
"I don't intend to use the drugs for too long because I believe that long term usage can cause complications for me" FGD 01-M54

Table 2 Examples of participant responses on specific topics about glaucoma (*Continued*)

Medication of no benefit
"As a blind person, I no longer use the drugs because I feel they are not useful to me since I cannot see".
"There was a time I defaulted because the drugs were not working for me". FGD 01-M54
Satisfaction with medication
"I am happy using eye drops but would prefer to be given spectacles" FGD 05-M49
"Drugs have helped to prevent the remaining part of my eye from complete blindness". FGD 05-M49
Acceptance of surgery
"I know people that have undergone glaucoma surgery and they are seeing better now".
"My sister was completely blind, but doctor X performed surgery and it was successful, but I don't know if her case was glaucoma". FGD 06-F69
"I have had surgery and can testify that I can see better after the surgery than I was seeing before the surgery too". FGD 01-M43
"I will accept an offer of surgery because from the information we received about glaucoma, surgery is the best option to avoid blindness". FGD 04 M38
"I have not rejected an offer of surgery from the hospital, but financial constraints made me delay the surgery". FGD 04-F45
Follow up
"Keeping follow up appointments will help us especially when we have problems with the drug or in an instance of side effects". FGD 04 M38
"You will come very early in the morning waiting to see the doctor, but you spend the whole day because they are seeing people who came after you, even if they are their staff or family. This is not fair and I don't want to quarrel again with anyone". FGD 06-F62
Communicating about glaucoma
"I can inform others about glaucoma based on the information I have received during this discussion". FGD 06-M47
"Most patients come to us after losing hope in the medications offered by the hospitals they visited" IDI 02-1
One traditional healer had strong views about the causes of glaucoma and how it should and should not be treated:
"Glaucoma and cataract are like younger and older brothers. They are caused by the bite of flies known as 'fuleria'. Once bitten by the carrier fly, a person is afflicted by the ailment and can carry the germ for up to 3 years or 4 years or sometimes for up to 5 years before it affects the mucus of the eye....once it starts the poison now changes the mucus to something like groundnut oil and becomes a cataract. If it is becoming glaucoma it doesn't separate - it mixes to

look like engine oil that has lasted too long in a motorcycle then it liquefies." IDI 01-1
 "My medicine makes the mucus dissolve like ice in water. It burns out the oily layer formed in the eye and the patient is cured...glaucoma cannot be treated by surgical operation. There is no doctor on the surface of this world that can convince me of that." ID I01-1

Adherence to medication

Most patients administered the drops themselves while a few had help from carers. Many elderly patients said they rely on their children, and women often relied on their husbands to buy the drugs, having little or no control over when they would be available. Most respondents admitted to not being very adherent to their treatment regimes (Table 2), giving a range reasons including lack of information about how to take their treatment. For example,

"I was not told whether to continue or just administer the drug when in need so I use it as occasion demands." FGD 06-F42.

Adherence to medication was also difficult due to costs and also availability, particularly for those living in rural areas who ended up purchasing drugs from other sources, such as local pharmacies, where the potency of drugs cannot be guaranteed.

The second commonest reason was forgetfulness or preferring other treatment.

"We sometimes run short of money to buy the drugs". FGD 03-M61

"Sometimes the drugs are difficult to get from the pharmacy shops, especially when the hospital pharmacy runs short of the drugs. Sometimes the drugs we buy outside the hospital pharmacy are not as effective as the ones we buy at the hospital". FGD 02-M45

"I try to take the drugs as prescribed by the doctors, but sometimes I do forget". FGD 05-F59

Quite a few patients said that they only use their drugs if they develop symptoms. Even though glaucoma has few symptoms apart from loss of vision, some patients claimed to know when the pressure is high as they develop headaches. Some patients understood that treatment preserved sight whereas others no longer used medication, as they were already blind or had poor adherence as they thought treatment should improve their vision. Some participants did not adhere to medication because of side effects such as headaches, hiccoughs, red eyes, gritty eyes and poor sleep. Some feared complications later in life.

"I use the drugs but when I feel better I reduce the frequency of using the drugs". FGD 02-M43
 "I have used the drugs for some time but there is no change in my vision, so I don't know whether the drug is working or not". FGD 06-F41

Acceptance of surgery

Most reasons for accepting or rejecting surgery were based on the experiences of others. Some patients reported that what they need is confidence in the doctor's advice and abilities, and a reliable, efficient service.

Fear of blindness, cost of surgery and the fear of surgery itself were reasons for not accepting surgery in some.

"I will accept surgery but the doctor must be sure that surgery is the best treatment for me". FGD 03-M35
 "There are difficulties in going to the hospital. One could spend the whole day without seeing the doctor then will be told to come back in a week or a month after spending transportation money...." FGD 06-F55
 "I am afraid of the surgery". FGD 06-F65

Follow up

There was general agreement that follow up is important because it will help the doctor address their problems and monitor progress of their disease. Many patients did not specify why they defaulted from follow up, explaining that the reasons were beyond their control, for those that did, lack of money, and negative attitudes of some staff which may reflect their views about the inefficiency of the service was a factor (Table 2).

"You will come very early in the morning waiting to see the doctor, but you spend the whole day because they are seeing people who came after you, even if they are their staff or family. This is not fair and I don't want to quarrel again with anyone". FGD 06-F62

Communicating about glaucoma

Most participants said that trained staff were in the best position to educate people about glaucoma. More than half said that glaucoma patients were in the best position to enlighten others. Most respondents said that the best means of creating awareness about glaucoma in the general population is through the radio, television and health talks whilst others mentioned household heads, community leaders, health organisations and government agencies (Table 2).

Discussion

This study explored patients' understanding of glaucoma, their health seeking behaviour and how they cope with the disease and its treatment in everyday life in

Bauchi, Nigeria. When illness strikes it is common in all societies to ask, 'why me? why now?' [50]. These questions are challenging in glaucoma even with biomedical knowledge, as the disease does not yet have a clear underlying cause. Lay explanations in this study included exposure to certain foods, wood smoke and crying, or supernatural or fatalistic causes, implying that this is what God had ordained for them. Eye care providers need to be aware of these views, and be respectful and considerate [50].

In this study some participants visited traditional healers either when they first noticed problems with their vision or once they had given up hope in allopathic services. From the author's experience, traditional healers are respected and trusted in northern Nigeria, having considerable influence on patients' and their carers' decisions: indeed, the word of the traditional healer is often believed above that of medical doctors. In this study some participants believed that traditional healers could cure their glaucoma. However, other participants were of the view that traditional healers could not be relied upon as they lack the ability to make an accurate diagnosis. This is supported by the interview with one healer who appeared to confuse glaucoma with onchocerciasis, saying that it followed the bite of a fly. This healer had confidence in his own treatment and was emphatic that surgery was not appropriate for glaucoma. To our knowledge this is the first study to interview traditional healers about glaucoma.

Understandings about glaucoma varied, with some patients having very good knowledge of the condition and its treatment whilst others had no awareness, hearing details for the first time during the study. The lack of a universally understood name for glaucoma in the majority Hausa community reflects that it is not a well-known disease. It is important to have a common nomenclature that describes glaucoma so that it is not mistaken for other treatable conditions such as cataract, for example, which can have tragic consequences. In this study the most fitting descriptions that correlate with the biomedical definition of glaucoma were *hawan jinin ido* (hypertension of the eye), and *taka shanya* (stumbling on objects without having seen them). The first derives from patients' understanding of hypertension which is quite common in Nigeria [51], while the second describes peripheral visual field loss typical of glaucoma and onchocerciasis. These terms could be used to create awareness in the community and in patient education, gradually introducing and popularizing the term glaucoma, as has been suggested in Ghana [52]. Lack of knowledge of glaucoma is commonly reported from developing countries such as Ethiopia [39] and India [44], but awareness can also be low in more developed societies such as Brazil [53] and in the USA

[54]. Greater awareness has been reported amongst those with higher levels of education [29] and is associated with more appropriate eye care seeking behaviour [42, 43].

In the Netherlands improving knowledge was considered best delivered by qualified staff, or representatives of glaucoma patients' societies, which requires trust in health professionals [55]. In our study some participants recommended peer-to-peer methods as a means of encouraging others with glaucoma to accept treatment, but there is the potential for misunderstandings to be perpetuated. Glaucoma support groups or clubs could also be formed, as have been established elsewhere, to aid interaction among patients with a view to improving awareness, knowledge and adherence to treatment [56]. Glaucoma support groups can also advocate for better availability of affordable medication, and encourage others to be assessed for glaucoma [56].

In our study some participants did not understand that the purpose of treatment is to preserve existing vision rather restore sight, which is one explanation for low acceptance and adherence as there was no perceived benefit. Other reasons included forgetfulness, side effects and fear that long-term use would accelerate blindness. Amongst those who did want to use medication cost, lack of medication in hospital pharmacies and difficulty in instilling eye drops were described. In this setting as elsewhere, these are legitimate challenges. Similar findings have been reported from Jamaica and the Netherlands [27, 57].

Fear of a poor outcome was an important reason why patients do not accept surgery. Combined cataract and glaucoma surgery is being advocated for Africa, even if there are only minimal lens opacities, so that patients experience some improvement in vision after glaucoma surgery [58]. Fear can be allayed in different ways: the HIV/AIDS program in Ethiopia used entertainment education to help patients cope with fear and to promote preventive actions [59].

Adherence to eye drops requires using the drug at the right time as well as delivering the drug into the eye, which can be challenging [49]. Several studies have shown deficiencies in self-administration of eye drops, including in Baltimore where 29 % of glaucoma patients were unable to instil their drops [60]. It is, therefore, essential that patients use reliable systems to remind them when to use their drops, and are trained to instil drops themselves, or others administer the drops. The extended family system in Nigeria would make the latter a feasible solution.

Adherence to medication in all chronic diseases is a challenge, and many interventions have been evaluated and could be adapted locally. Interventions include motivational strategies for hypertension [61], and education

or counselling for latent tuberculosis [62]. Intensive reminders and 'implementation intention' interventions appear promising in antiepileptic mediations [63] and patient support and education for antiretroviral therapy [64]. Although complex interventions consisting of patient education combined with personalised behavioural change interventions, including tailoring daily routines to promote adherence to eye drops, may improve adherence in glaucoma there is insufficient evidence to recommend a particular intervention [65]. A major review of use of education to improve adherence demonstrated that educational interventions led to a significant improvement in medication adherence or a trend in improvement [66].

In our study several participants complained of inefficient services with long waiting times and poor attitudes of staff, which made them reluctant to attend for follow up. This needs to be addressed by reorienting and educating staff to be more patient friendly and by improving patient care pathways.

Limitations

In this study only two traditional healers were interviewed, and all patients had advanced glaucoma whose views and experiences may differ from those with less advanced disease. All participants came from northeast Nigeria and the findings may not be applicable in other regions of the country where levels of education and socio-economic status are higher and where there are religious and cultural differences. Analysis was undertaken using translations of the transcripts and some nuances in meaning may have been lost, but the mother tongue of the first author is Hausa.

Conclusions

Multiple interventions and approaches are required to reduce glaucoma blindness, the "silent thief of sight", in Africa. Important elements include increasing awareness using locally derived terms so that patients present earlier; improving primary eye care for earlier detection and referral; improving the education of glaucoma patients about their disease and their role in controlling it; improving the quality, capabilities and efficiency of services and the attitudes of staff; ensuring the availability of affordable eye drops and teaching patients or their carers how to instil them, and evaluating interventions appropriate to Africa to improve adherence to topical medication, acceptance of surgery and long term follow up.

However, before demand for glaucoma services are generated in the community, interventions are required to improve the knowledge, acceptance and adherence to treatment amongst patients who present to eye departments in Africa with glaucoma. The findings from this study have been used to adapt a counselling technique

known as motivational interviewing for glaucoma in the African context, which is being evaluated in a randomized controlled trial in ATBUTH [67].

Ethics approval

Ethical approval was obtained from the Ethics Committees of the London School of Hygiene & Tropical Medicine and ATBUTH. After explaining the study they were given an information sheet or this was read out to them to obtain preliminary verbal consent. If they agreed to participate they were given information sheets to take home and a date to come back for the FGD. On the day of the discussion written consent was obtained by signature or thumbprint. Permission was explicitly obtained to record the discussions. The escort was also asked to give consent and allowed to participate. All participants were provided with refreshments and transport costs were reimbursed when needed.

Availability of data

Transcripts from this study are available for sharing upon request. All identifying and confidential information about participants will however, be removed.

Abbreviations

ATBUTH: Abubakar Tafawa Balewa University Teaching Hospital; BCPB: British Council for Prevention of Blindness; FGD: Focus group discussion; FM: Frequency Modulation; HIV/AIDS: Human Immune Deficiency Virus/Acquired Immune Deficiency; ICEH: International Centre for Eye Health; IDI: In-depth interview; USA: United States of America.

Competing interests

The authors declare that they have no competing interests.

Authors' contributions

MMA: Research design, data acquisition, data analysis and interpretation, and manuscript preparation. CC: Research design, data analysis and interpretation, and manuscript preparation. CG: Research design, data analysis and interpretation and manuscript preparation. All authors read and approved the final manuscript.

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GLAUCOMA – THE SILENT THIEF OF SIGHT PROGRESSIVE DAMAGE OF YOUR FIELD OF VISION			
NORMAL (FULL VISUAL FIELD)	MODERATE VISUAL FIELD LOSS	SEVERE VISUAL FIELD LOSS (TUNNEL VISION)	BLIND
			
DON'T ALLOW THIS THIEF TO STEAL YOUR SIGHT – ACCEPT RECOMMENDED TREATMENT USE YOUR MEDICATION AS PRESCRIBED AND MAINTAIN REGULAR FOLLOW UP			

Figure 4: The silent thief, printed leaflet given to every new patient attending the glaucoma clinic

Chapter 3: Motivational interviewing (MI) – theoretical: use in other conditions

Motivational interviewing (MI) was developed by Miller, W. R. and S. Rollnick in 1983, has a connection with the trans-theoretical model (TTM) of health behaviour change. This model describes six stages patients go through: pre-contemplation, contemplation, preparation, action, maintenance, and termination.[194] The TTM is intended to provide a comprehensive conceptual model of how and why changes occur, whereas MI is a specific clinical method to enhance personal motivation for change.[195] The most obvious connection between motivational interviewing and the stages of change is that motivational interviewing is an excellent counselling style to use with clients who are in the early stages. Pre-contemplators do not want to be lectured to or given “action” techniques when they are not ready to change. Likewise, contemplators, who are considering the possibility of making a change but are not quite ready to make a commitment, are resistant to more traditional approaches that encourage (or try to force) them to make changes for which they are not yet ready. [196] A technical therapeutic definition of MI is: “Motivational interviewing is a collaborative, goal-oriented style of communication with particular attention to the language of change. It is designed to strengthen personal motivation for and commitment to a specific goal by eliciting and exploring the person’s own reasons for change within an atmosphere of acceptance and compassion”.² It is a client-centred counselling style for eliciting behaviour change by helping clients to explore and resolve ambivalence.[197] Motivational interviewing is built on four fundamental processes. These are Engaging, which is the relational foundation, Focusing the strategic focus, Evoking the transition to MI, and Planning, which is the bridge to change. The underlying spirit of MI is that of Acceptance, Compassion, Evocation and Collaboration. Critical in MI is the expression of empathy, that is seeing the world through the client’s eyes, thinking about things as the client thinks about them, feeling things as the client feels them, sharing in the client’s experiences. The guiding principles of MI are:[198]

- a. Resistance of the righting reflex,
- b. Understanding the patient’s motivation,
- c. Listening to the patient and

² William R. Miller, Ph.D, Stephen Rollnick, Ph.D: Lecture: Motivational Interviewing, What It Is, How It Works, How To Learn It, Motivational Interviewing Workshop, Cardiff, Wales, UK. 10-12 June 2012.

- d. Empowering them.

In practice MI uses the three core skills of asking, listening and then informing.[198] The listening is usually reflective. Listening for “change talk” is divided into preparatory change talk (**DARN** below) and mobilising change talk-resolving ambivalence (**CATs**) below.

- i. **D**esire to change- e.g. wish
- ii. **A**bility to change- e.g. could
- iii. **R**easons to change- e.g. if
- iv. **N**eed to change- e.g. I ought to
- v. **C**ommitment- e.g. I am going to,
- vi. **A**ctivation (willing, ready, preparing)
- vii. **T**aking steps-statements about action taken.

This change talk is usually responded to by: (**EARS**)*

- i. **E**laborating: Asking for elaboration, more detail, in what ways, example, etc.
- ii. **A**ffirming – commenting positively on the person’s statement
- iii. **R**eflecting, continuing the paragraph, etc.
- iv. **S**ummarizing – collecting bouquets of change talk

There is a specific way of giving information and advice in MI*

- i. Get permission
- ii. Qualify, honouring autonomy
- iii. Ask – Provide – Ask
- iv. For suggestions, offer several, not one

The important components of MI include building rapport, avoiding resistance, selecting an agenda, assessing readiness to change, addressing ambivalence, determining the level of importance of the issue and evaluating the level of the patient's confidence in his or her ability to change.[159]

Motivational interviewing has shown promise in adherence to treatment in outpatients in psychiatry. For example, in a trial of treatment adherence among psychiatric and dually diagnosed patients, the proportion of patients who attended their first outpatient appointment was significantly higher in the MI group compared with control group.[158] In substance abuse, a Cochrane review concluded that MI could reduce the extent of

substance abuse compared to no intervention.[199] In a randomised trial in HIV patients failing or initiating ART care, 29% of the treatment group achieved >95% adherence to antiretroviral therapy (ART) compared with only 17% in the control group. After controlling for ethnicity, the intervention group had 2.75 times higher odds of achieving more than 95% adherence than controls.[157] Trials of MI for smoking cessation among adolescents and adults showed that there was a higher odds of cessation in the MI group (OR 1.45; 95% CI 1.14-1.83).[200] However, many of the reviews comment on the variation in quality of study designs, and the role of publication bias.

Fidelity of Motivational interviewing

Fidelity is the extent to which delivery of an intervention adheres to the protocol.[201] In MI many measures of fidelity have been used but the most popular is the Motivational Interview Treatment Integrity scale (MITI). This is a brief scale designed to evaluate the integrity of the use of MI. It is a cost-effective and focused tool for evaluating competence in the use of MI. It can be used for self-evaluations, assessment of the effectiveness of teaching strategies, and individualized feedback to improve MI competence for clinicians in training.[202] The MITI assesses six criteria: empathy, MI spirit (autonomy, evocation and collaboration), MI adherence (asking permission, affirmation, emphasis of control and support), MI non-adherence (advise, confront and direct), the types of questions (open or closed) and the number of reflections. It is an invaluable tool in research for measuring fidelity of MI.

Training implications

Training in MI has been done in several ways with workshops being the traditional method comprising two to four days of lectures, role-play or simulated patients. Teleconferencing [203] and web-based training have also been used. A two-day training workshop showed an increase in skills in staff of probation service but this was not maintained at three months. [203] In a study with medical students trained in MI for smoking cessation, there was no difference in training through role-play or using student colleagues when teaching basic MI skills for smoking cessation.[204] Motivational interviewing is a skill that can be taught at most levels. A study showed that peer outreach workers (paraprofessionals in HIV care) can be trained in MI with good fidelity.[205]

Learning motivational interview; our experience

The purpose of the next paper is to document our experience learning and practicing MI. As a first step it was necessary for the principal researcher and the interviewers to be proficient in the delivery of MI. The literature has shown that MI can be easily taught to people with a wide variety of skill levels. The principal researcher attended a series of training sessions about MI, and in turn used what he learnt to train three interviewers. Together they trained and practised to reach a level of proficiency that was sufficient to adapt the counselling technique and used it with good fidelity in the study.

The following paper, which has been submitted, documents our experience learning and using motivational interviewing.

1. Learning Motivational interviewing, our experience. M M Abdull, F Muazu, Joy Rengwen, A Ahmad Submitted to Motivational interviewing training research implementation practice (MITRIP) journal.

Paper 6: Learning motivational interview; our experience.

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SECTION A – Student Details

Student	Mohammed M Abdull
Principal Supervisor	Clare Gilbert
Thesis Title	Adapted motivational interviewing to improve uptake of treatment in glaucoma patients in Bauchi state, Nigeria

If the Research Paper has previously been published please complete Section B, if not please move to Section C

SECTION B – Paper already published

Where was the work published?	
When was the work published?	
If the work was published prior to registration for your research degree, give a brief rationale for its inclusion	
Have you retained the copyright for the work?*	Was the work subject to academic peer review?

*If yes, please attach evidence of retention. If no, or if the work is being included in its published format, please attach evidence of permission from the copyright holder (publisher or other author) to include this work.

SECTION C – Prepared for publication, but not yet published

Where is the work intended to be published?	Motivational Interviewing: Training, Research, Implementation, Practice (MITRIP Journal)
Please list the paper's authors in the intended authorship order:	Mohammed M Abdul, Fatima Muazu, Joy Rengwen, Amina Ahmad
Stage of publication	Submitted, Under review

SECTION D – Multi-authored work

For multi-authored work, give full details of your role in the research included in the paper and in the preparation of the paper. (Attach a further sheet if necessary)	Wrote the introduction to the paper, a brief on our training efforts and the part on my role in the process. Produced the final draft
--	---

Student Signature: _____

Date: 15 December 2016

Supervisor Signature: _____

Date: 15 December 2016

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Learning Motivational interviewing, our experience

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Glaucoma is a chronic blinding eye disease. It is the second commonest cause of blindness worldwide [5] and in Nigeria. [7] Glaucoma is of particular concern to Africans because of the unique challenges they face.[206] Black populations have a higher prevalence of glaucoma in all age groups [22, 207] and patients in Africa often present very late to the hospital with advanced disease. [51, 208, 209] Blacks are also less responsive to both medical and surgical treatment for glaucoma.[58, 94] They also have reduced (limited) access to treatment and are less aware of the risks of having glaucoma.[58, 192] Accepting surgery is a particular problem because of fear of blindness resulting directly from the eye surgery, or just plain fear of any type of surgery[210] but also because it is not associated with improvement in vision as in cataract.

Motivational interviewer 1

As a clinician dealing with patients, I always gave instructions to patients about how to use medication, how to look after them after surgery, and how to come to hospital for follow up. I have never had any formal training in counselling or how to talk to patients apart from what I learnt in Medical School and in specialty training. The training most doctors have is to give directives or information to patients, not really knowing whether the patients grasp what we were communicating or not. When patients do not return for follow up, or fail to use their medication as prescribed, we tend to show concern for their

health or even get angry with them for not abiding by our instructions. We get surprised when despite the severity of the patient's problems they fail to adhere to medication or instructions. We talked to patients, gave them materials to read but all to no avail.

I first heard about motivational interviewing (MI) from a meeting with one of my review panel members. I did some research about MI and from what I gathered in the literature review, there was no doubt that MI has worked well.[211] It was quite fascinating for me to learn that a counselling technique that can be conducted in an hour or less and with one or few sessions can help people addicted to drugs [199, 212]. So if MI can get people to stop drugs, imagine what it will do to patients just to continue using their eye drops without fail? At that time I did not even know that it had been used in other medical fields such as diabetes, hypertension, [156] diet control or just plain drug adherence in many diseases. My major concerns are for my glaucoma patients to come to hospital early, accept surgery or laser treatment if indicated, adhere to their medication regime and to continue their follow up schedule for monitoring intraocular pressure and general progress of their vision. I searched the literature to see if anyone had used this to get glaucoma patients to adhere to or accept treatment for blindness prevention. My search came up with an instance where MI has been tested for feasibility in glaucoma management and was found to have potential for improving adherence.[213]

Soon after I was introduced to Jim McCambridge. We had a discussion and he gave me a book titled *Motivational Interviewing in Health Care*. [214] It was most interesting to read the book. As I read further, it all began to make sense. Within a short time I finished the book and started over again. This time I started practicing what I had learnt on my friends. I found among other things that I became a good listener, and was able to understand people more. I had a lot of practice, asking open-ended questions and responding with two or more reflections per question.

On coming back to my clinic I shared my book with my assistant. Together we met every evening to practice what we had learnt from the book. After some time, we started interviewing each other as simulated patients using role play which has been found to be effective as a learning tool.[215] We did that a lot before starting to practice with real patients. We recorded every interview and later sat down and played it back to critique ourselves. We sought to find out how many times we used closed questions as opposed to open-ended questions, the number of reflections we gave for each question, and also affirmations and summaries. It was quite surprising for me to find out much later that

something similar to that called MITI (Motivational Interviewing Treatment Integrity Scale) is actually being used for fidelity testing in MI, and there are people who do just that.[216]

At that time we had the tendency to give too much and often unnecessary information to patients. We were working on ask, listen and tell. We fed patients with too much information about glaucoma even when they did not ask for it.

I heard about the introductory course to MI in Cardiff, South Wales, so I registered and attended. Prior to this time, I had not had any training on MI. The course was very important to me. It exposed me to what MI really is from W. Miller and S. Rollnick. There was an opportunity to discuss and practice with people who had been involved in counselling and MI for some time. It was a novelty for me to meet and even have discussions with W. Miller and S. Rollnick, who were quite pleased with my interest in MI. As the only ophthalmologist there - probably the only person from sub-Saharan Africa - and the only person not working either as a counsellor or in the addiction field, I was a curiosity for many participants, and they wanted to hear more about what I was doing and how I thought MI will help my patients. I had the opportunity to trade stories with many interesting people and share ideas with them and also learned a lot from them.

Furthermore I attended a workshop and conference on MI in Venice, Italy, and I had another opportunity to meet with many people who were experts in or working with MI. I had the opportunity to discuss with such big names in MI as T. Moyers from the US.

Ever since attending the two workshops and conference, I feel I understand MI much better than I did before. I have been sharing all that I have learnt about MI with my three assistants who have never had any training in counselling before. They are graduates who majored in physiology, microbiology, and English respectively. We spent more than a month reviewing the MI book, publications about MI and practicing with each other and with patients. As before, we recorded our interviews and reviewed them, giving scores for open ended questions, reflections, affirmations and good summaries. With further training I realized that we would often finish a 45-minute interview without giving the patient any specific information about glaucoma, but still getting them to commit to have surgery by the end of the interview.

It was especially interesting for me to find out that even middle cadre staff or workers can be trained to deliver MI.[217] Thinking about this, it means that if effective, we could easily train existing staff instead of having to employ specialist trained counsellors who are scarce and their employment will cost us more. Since my contact with MI I have shared what I know with four ladies who will eventually work in the clinical trial. MI was originally designed for western audiences, but over time, people have tried it in other ethnicities and in many countries even in sub-Saharan Africa. Studies have been done and it has been found to have good outcome in people of different ethnicities. [157] This is also one of my motivating factors that perhaps it will also work in the ethnic population I want to apply it to.

Of course, as people learning MI, we had a lot of challenges, some to do with our patients others with us. One of the bigger challenges is doing the interview in a language other than English. With English, there were simple and familiar sentences and phrases that we could use. Sometimes it was difficult framing a question in the local language, Hausa, or a response that translates to or portrays the appropriate meaning intended. But gradually we developed a series of ways to ask particular questions in the language so that the patients can understand. A particular difficulty is affirmations in that language, which sometimes in the middle of an interview seemed patronizing to patients. We had to find ways around that. When practicing DARN-CAT, we collected phrases especially in commitment and activation language and translated them into Hausa with the help of lay people and patients. We came up with simple, easily understandable phrases, sentences, and responses that fit the local colloquy.

It is not enough for us to adopt and adapt MI and just start using it without evidence that it will have any impact on the management of our patients. That is why we started our planned randomized clinical trial to assess the impact of adapted MI on acceptance of surgery, adherence to treatment, coming for follow up and ultimately control of intraocular pressure in our glaucoma patients. When the trial is over, depending on the outcome, we can then use the evidence we have to plan training of counsellors to routinely interact with outpatients.

We have now been interviewing patients for about 12 months. Over this period, we have learnt a lot about MI as well as about our patients. There are some unique challenges that we face in this place that may not be the same in other places. Some of these challenges are discussed below.

Some participants have this blind faith in God that makes them not respond well to questions or prompts on what they will do or intend to do. They always say things like “only God knows” or “God will do it” or “It is in God’s hands” or “That is the way God wants to see them”. For instance, you ask someone what strategy will he use to remind him to use his medication on time? The answer will be “God will do it” or something similar. I usually go ahead to suggest examples like how about asking his wife or anyone at home to remind him of the time for medication? It becomes difficult to get such people to commit or take action as they expect God to do that for them.

Many of our participants are used to being directed to do things, so they find it strange that we should ask their view on something or what they intend to do. In many there are clear signs of discomfort, as they think they are being assessed. One patient actually asked if marks would be awarded to him, as if it was an examination. Their expectation is to be told what to do by us not the other way round. An elderly woman in the clinic once said “Please doctor, stop asking me what I would do. Just tell me what I should do”.

Participants tended to open up more to talk about the eye problem, how it started or presented, what they did etc., but not what they would do to help themselves. Some just don’t want to disappoint the MI interviewer so they say what they think we want to hear and it becomes a task to get them to tell the reality. I found that they were more open with my assistants than with me. They think as their doctor, I will not be happy if they told the truth that they have not been regular on their medication, this is due sometimes to “white coat fear”. It is partly for this reason that the interviews are not done by doctors in the trial.

Some have too much dependence on family members, guardians, or husbands that they cannot even show intent to commit to anything on their own. There are instances where patients would be hesitant to respond to prompts, until they go back home to consult. They actually even want the questions we asked to be directed to the husband/son etc. to answer for them. This has to do with local customs where parents speak for their children or husbands for their wives. They are not used to having their opinions heard or being involved in making decisions even about their health or welfare.

Some participants needed very long and detailed explanations about confidentiality before they could relax and have a proper discussion with the interviewer. Some are

afraid that if they told the truth the information will get back to their employers or sponsors with adverse effect. In these cases engagement took more than half the interview.

The usual presentation of our patients is with blindness in one eye and advanced disease in the other. One role MI can play here is to get the interviewed patients to refer their first-degree relatives for screening so that the disease can be diagnosed early before major damage to vision ensues. Being a first degree relative is one of the important risk factors for glaucoma,[218] the prevalence of the disease being higher in them[219] therefore it gives us an opportunity to target those who are at risk. Motivational interviewing is an exciting thing for us here. We are yet to know the impact it is making on our patients until we conclude the randomized clinical trial. We are not going to pre-empt the trial but we are still hoping it will be a key that will help us to reduce the alarming rate of blindness from glaucoma in this locale.

Motivational interviewer 2

My journey with MI started about two years ago, when I was just starting to get the hang of my job. It began when our ophthalmologist came back from a trip to London. I felt that there was a slight, subtle, almost imperceptible change in his attitude in general towards both patients and the people he worked with. I never really gave it a second thought until he told me about MI. It was the tool he was proposing to be the intervention in his impending research project.

At first I was curious about this form of counselling, but as I read about it, I was intrigued and surprised. I realize it could just be the tool for boosting self-confidence, self-liberation, and self-realization of boundaries.

Motivational interviewing is a form of counselling that encourages the counselled party without pressure. It is focused on guiding rather than directing and support is given by exploring a string of possibilities for a particular situation, sort of like a multi-dimensional way of analysing a situation. Unfortunately, people here are more comfortable at getting directives from personnel. Many a times participants feel they do not have what it takes to make simple decisions, such as agreeing to an MI session, or

even coming to the hospital for treatment. They tend to lean on either the interviewer or seek permission from influential family members.

There's also evoking involved in MI, which gives room to explore one's inner self, thus establishing trust. Once this is accomplished, more issues may surface in the discussion and with open ended style of questioning, focusing on important issues, setting priorities and setting agendas, change talk may be achieved which leads to planning practical positive change.

My training in this fascinating tool involved role-playing and lots of practice. I had plenty of opportunity to do that and because I developed a deep interest in it, I inculcated it in my daily interaction with people, be it at home with my family or at my working place. My job entailed obtaining consent from patients willing to participate in our research project activities such as focus group discussions, one on one interviews, interviews with traditional medicine people, even ordinary conversations with patients and their escorts on compliance issues.

Of course there were challenges that I had to find a way of overcoming. I got some suggestions on how to address some from my MI mentor and some I had to figure out myself. For example, in spite of assurance of confidentiality, some patients still harbour trust issues. There was an instance where a female patient was scared of having an MI and hurriedly left under a false pretext and never returned. Some patients do not want to discuss any topic no matter how far fetched or trivial the issue is from the focus of discussion. The culture of our society is one that looks upon counselling as intrusive. This raises suspicion and most people react in various ways in defence to barricade any form of discussion with them, thus comes the importance of sincerity and empathy on the part of the interviewer. This I think is the basis for building trust, without which there won't be a holistic MI interview.

There was the challenge of relating meanings from the English language to Hausa, which is the local language most of our patients understand. We also encountered many clients in denial. Most of our clients are end stage glaucoma patients. They tend to be very conscious of their non-sightedness thus retreat into their shells or attack in defence. This is mostly as a result of societal taboo or from oppression right from their homes.

Uneducated patients, especially women, prefer to have MI sessions with a relative present with an inclination to redirect questions meant for them to the relative.

Motivational Interviewing is flexible enough to be used by moms with children's tantrums, doctors with their undecided patients, teachers and their students, police interrogation, even in prisons such as those under Parole and one's self for dealing with ambivalence, the list is almost limitless. Any change or decision made as a result of a well conducted MI is mostly done with conviction and no matter the outcome, the client always feels responsible with no ill intent or blame because the decision was self-made without goading, rather it is just another lesson learnt and will mostly be viewed as part of experience, which is the best teacher.

In general, MI promotes the feeling of "you have what you need". It is a continuous journey filled with lots of experience; it is a door way to a whole new world of possibilities waiting to be explored. I have come a long way with it, learnt a lot from it, benefited from it. I think I am a better listener and it makes one to look at problems from different perspectives, giving a deep insight to situations. I am looking forward to learning more of it.

Motivational interviewer 3

The training started with four of us present; that is three interviewers, and our doctor who is the resource person. The training lasted for a week initially, and then subsequently we started practicing with ourselves and with some clinic staff.

On the first day of the training, Dr Abdull briefed us on the general overview of the disease (glaucoma) beginning with the structure of the eye, then the disease itself. It was interesting to know about glaucoma as an eye disease, its effects, its treatment, and its prevalence around the world. Dr Abdull took his time to elaborate on each topic so as to help us get acquainted with the disease, which will help us in the course of the research.

Motivational Interviewing was introduced, the history of MI, how it works and how to learn it. Before then we were given some material on MI to read and get acquainted with, including the book by Rollnick, Miller, and Butler (Motivational Interviewing in Health Care). It was a little boring at first before the introductory section but as we started the training it all began to make sense and became more interesting for me. The first for me was having the knowledge that MI is a client's self-motivation interview unlike other counselling styles. Motivational interviewing has to do with asking open ended

questions, affirming, reflection and summary (OARS) which during the course of our training we learnt to be the basic skills of MI, used to motivate a client towards change and to avoid the righting reflex.

During the training we learnt the fundamental processes in MI, which are engaging, focusing, evoking and planning. We were also lectured on how to use importance scale ruler in setting priorities, agenda setting, recognizing change talk (DARN-Desire, Ability, Reason, Need) mobilizing change talk (CAT-Commitment, Activation, Taking steps) responding to change talk (EARS- Elaborating, Affirmation, Reflection and Summary) and avoiding discord and sustain talk. In the course of the training we practiced each topic we were taught. We had difficulties during practice and were tense, especially if Dr Abdull was present, having the fear we won't do the right thing. Sometimes we were assigned roles to play, one being the client another the interviewer and the other as the observer, after which we switched roles. Sometimes we brought in a patient and one person interviewed while others listened, after which we all analysed and critiqued the session. We had take-home assignments for each day, such as to translate some English words and phrases into Hausa since it is the commonest language used among our people. There were days when we watched videos from YouTube, which helps us see interviews done by professionals. The training periods were so serious that we had to come to the hospital during weekends.

The most interesting part of the training was how we practiced and dramatized each topic, and the most challenging part was the translation of what we learn in English into Hausa. Other challenges we experienced were listening actively during an interview session while being conscious of reflecting and at the same time asking open-ended questions, also knowing the fact that one is being recorded to be assessed. At times I go back home discouraged, especially if I did not perform well in the training class. I had serious problems using Hausa during translation and interview sections, and I remember Dr Abdull telling me the other interviewer was better than me, which made me pick up the challenge to do better. I had to practice at home with my family members using Hausa as much as possible. At the end he was very pleased with my progress, which made me happy. One other problem I encountered was how to re-direct a client who is going out of the context during an interview without them feeling interrupted, most times I allow them go out for a long time. After listening to one of my interviews, Dr Abdull made me realize my mistake, so I was able to effect the corrections he made in my subsequent interviews.

My first interview with a client was not too good, because I was conscious of my questions, reflections, and summaries. Most times I summarized instead of reflecting, and asked closed questions. Fortunately for me, I had an easy flowing patient, and I could have explored more if I had asked good open-ended question. Subsequently I became less conscious and I applied my skills at ease, though still improving by practicing and learning from Dr Abdull and my colleagues. At the beginning of the pilot study, most interviews lasted for 15-25 minutes but Dr Abdull insisted that a good MI should last for at least 30-60 minutes. As time went on, there was an increase in the length of time in my interviews (25-45 minutes). All interviews were recorded and some were listened to, and analysed by Dr Abdull. Most interviews were carried out in Hausa, except for a few that used both Hausa and English at the same time. Discussions in interview sessions were centred on acceptance of surgery, medication, follow up and knowledge about the disease glaucoma. After each interview a form is filled in with their study number, duration of interview, their comments, and the interviewer's comments.

However, most of the challenges we had during interview sessions were with patients that have some education, who always feel they know it all. Some believe they are doing us a favour by participating in the study. Recently a man was asked to cooperate during a session and his response was "Do it anyhow, after all it is for your own good, I am only helping you do your job"

Those that are well educated and those that are not educated completely tend to see the need to talk things out. I also had a problem with non-literate housewives who are completely dependent on their husbands. Some women, whether literate or not, depend on their husbands for decisions. A woman once said whatsoever her husband orders her to do is final. In the course of the pilot study I was privileged to interview about twenty patients, mostly male. Most of the female patients preferred sessions with a relative or her household head present. Most patients feel reluctant to talk at the beginning of the interviews, but in the middle of the session they open up into discussion.

Professor Clare Gilbert visited us towards the end of the pilot study and went through the MIG (Motivational Interviewing for Glaucoma) interview forms and commented on them. Though I was tense during her visit I later became more encouraged and confident after her affirmation. We had a challenge during her visit with a patient who was willing to have MI but her husband refused. We had to revise the MIG form, giving a column for

reasons why an interview did not take place. In the course of the research, I had different experiences. I had interview sessions with patients who will not want to talk no matter how you try to evoke. Some might be due to fear and lack of exposure (especially women), and will not want to come back for another session if they are asked to come back.

After the pilot study, I had the privilege of undergoing another training on MI. During the training we had a new staff member. Dr Abdull repeated everything we did in the first training; we were assigned roles to play, watched YouTube, and also tried to create possible open-ended questions that we might like to ask. That also helped me to improve my skills on MI. All through the study to date I've had the privilege to counsel many patients along with their relatives in over eighteen sessions.

Learning and practicing MI was not an easy task. It's one of the greatest challenges I had in my lifetime. However, it has given me a new way of interacting with people and getting people to do what they are supposed to do without stress.

I as a whole have helped patients in the clinic feel cared for and being attended to, it gives them the confidence to approach their problems and want to come back again for hospital care. As an individual, learning MI has been a great challenge, getting perfect at it is another process, which one has to learn to listen and attend to patients, and let your patient become your teacher. MI has helped one to interact with people and help them motivate themselves.

Motivational interviewer 4

A Tuesday was the day my Team leader began training me as a motivational interviewer. It was also the very first day I heard about MI. The session commenced in the afternoon with two of those already trained in MI in attendance.

On the first day of the training, I was briefed on the historical background of MI and how it is being used in health care. Initially, when I heard the term 'motivational interviewing' the first thing that came to my mind was questioning. I thought it was just like the ordinary interview done by journalist but with a slight difference, and since it is a motivational interview all the interviewer has to do is question the patient/client, after which the interviewer counsels, advices, and convinces patients/client on what the

interviewer thinks is best and right for patient/client. After the briefing my perception changed and I thought for a while, this is going to be a great challenge. Though I was ready to face the challenge, at the same time I had fear of not doing the right thing or disappointing my employer.

The first lecture was about the basic skills used in MI, which are open questions, affirmations, reflections, and summaries (OARS). It was really interesting learning these skills for the first time. After the lecture, we all practiced the skills together. I was given the book on Motivational Interviewing in Health Care to read in order to have more insight on what I was being trained in. As the training continued, I learnt a lot about MI, some of which included the communication styles in MI (i.e. directing, guiding, and following), and the fundamental processes, which are engaging, focusing, evoking, and planning. We practiced every topic after the training. This phase of the training lasted for two weeks. I was given articles to read and also referred to YouTube to watch MI videos done by professionals.

The second phase of the training was on glaucoma eye disease. It was not my first time of hearing about the disease, so it did not sound new to me, but all I knew was that it was an eye disease and that's all I could say about glaucoma. The training started with a lecture on the eye itself. A labelled diagram of an eye was used in the lecture. I learnt about parts of the eye and their functions. Initially, I thought blindness caused by glaucoma could be reversed just like in the case of cataract. In the course of my training, I was able to know the difference between the two eye diseases (glaucoma and cataract).

The whole training lasted for a month and within that period I became familiar with the skills, styles and fundamental processes of MI. Since then patients have been assigned for me to interview. My first interview was nothing to write home about. I was really tense before and after the interview. After every interview, we all sat and listened to the interview, and then our trainer analysed and critiqued it. He said the essence of analysing and critiquing is not to make me feel bad but so I can realize my mistakes and help in improving my skills. The first problem I encountered was how to ask open questions - I had asked two open and closed questions in a row instead. Summarizing was also a problem as I summarize unnecessarily. Affirmation and reflection were a lot easier to learn. Another major problem was having short interviews. A good interview is supposed to last for thirty minutes or more. I had a problem meeting the appropriate time frame given for an interview. So, with the help of the analysis and critique, I was

able to realize my shortcomings. I sometimes experience nervousness before and after interview. I hope to overcome that soon.

I had interviews with patients with different personalities, some co-operative and some not co-operative. I could remember one fateful day (though I can't remember the precise day) I had an interview with a very co-operative patient, so when the interview was listened to, our trainer said it was a good interview because I was able to overcome most of my shortcomings in the previous interview and so he affirmed me. That day I went home happy, I couldn't help but to pick my phone and I call my sisters and told them that "I have made progress in my place of work today".

Some of the problems I had in the course of my training were interviewing old people. I could remember interviewing an old lady who got scared when I told her that we are going to have a discussion with her concerning her eye health. Her facial expression changed immediately and asked "has some terrible thing happened to my eye?" So I tried calming her down though she agreed to do the session but one could see it all over her that she was not very comfortable and refused the refreshment I offered her. Another encounter was with an old man whose interview began smoothly but along the way he felt the absurdity of the interview since he is not sure if his medical bills will be taken care of, saying "Are you people going to be responsible for my medical bills with all this questioning?" Most people feel the importance of being part of this research and their response is in most cases "I am here to be treated, so just do what you think is right".

The languages we use for MI here with our patients are English and Hausa depending on their choice. Learning MI was really a great challenge to me because, as an interviewer, you have to be conversant with the two languages. Most of the clients here are Hausa speakers though we do get English speakers too, but on rare occasions. One of my challenges was translating English into Hausa.

With reference from the Motivational Interviewing in Health Care book I read, MI helps in building up people's confidence. It also communicates, "You have what you need" instead of "I have what you need". Motivational interviewing is a method for helping people explore their own motivations.

Motivational interviewer 1

Knowing our limitations with MI, such as our level of training, the language, different culture, different conditions and disease, we hold no illusions that we were doing “by the book MI”, therefore we have termed it adapted MI. We are applying the core principles of MI under different circumstances aiming to get that change talk or commitment for change.

It is now more than two year since my first contact with MI. We have carried out a pilot study of adapted MI in improving uptake of glaucoma surgery or laser. The unpublished results of a pilot study have shown some increase in acceptance of surgery or laser with MI. To ensure that we were doing the right thing considering all the limitations we have about MI in a different set up, we intend to send some scripts for some form of MITI coding. Some preliminary assessment of some of our interviews by experts has shown them to be okay considering all the limitations above.

The main trial of adapted MI on acceptance of surgery or laser has just started here in Bauchi. Eligible patients are those diagnosed in the clinic with glaucoma that have been recommended surgery or laser treatment. These patients are randomized to either have usual explanation from a doctor plus an adapted MI session with an interviewer, or just the usual explanation by the doctor. Those randomized to MI are further assigned at random to one of two interviewers. The expected major outcome is having surgery within a specified period of the given surgery appointment date for the patient.

Learning MI has been a novel, exciting and enriching experience for me. It has been a journey of discovery for the impact it has made not just on my professional working life but on my personal life and relationships as well. I am a better listener since I was introduced to it. I am more emphatic when dealing with my patients and other people. I now try to understand things from their own perspective. I no longer confront my patients or indeed other people with the *righting reflex* telling them what to do. I guide them on this journey of self-motivation till they express their opinion on the why, when and how they plan to achieve the change for the erstwhile elusive goal we seek.

Motivational interviewing has shown some promise in the pilot study that we did. If the trial shows that MI certainly works, I think we can count that as an innovation that can be easily replicated and scaled up to help not only glaucoma patients but patients with other chronic diseases where poor acceptance and adherence to treatment are a challenge.

ACKNOWLEDGEMENTS

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Chapter 4: Context of the studies



Figure 5: The new eye clinic in ATBU Teaching Hospital, Bauchi where this study was carried out.



Figure 6: Female and male patients waiting to be seen in ATBUTH eye clinic

Location of study; catchment population, usual practices for glaucoma

The study was carried out in the Abubakar Tafawa Balewa University Teaching hospital in Bauchi town, which is the capital of Bauchi state. The hospital became a teaching hospital in 2010, and is one of three tertiary hospitals in the state. The state and parts of neighbouring states form the catchment population of the hospital.

Bauchi state is one of Nigeria's 36 states and is located in the north-eastern region of the country. Kano and Jigawa bound it in the north, by Gombe and Yobe in the east, Kaduna in the west, and by Plateau states in the south (Figure 3).



Figure 7: Map of Nigeria showing Bauchi state

Population and demography

Bauchi state has a population of 4,676,465 - (51.88% males). The population structure is pyramidal in distribution indicating low life expectancy, high birth rate, and high death rate. There are many ethnic groups in the state with many languages, but almost everyone speaks Hausa. English is the official medium of communication and is spoken widely especially in the capital city.

Administrative, political and economic structure

The state is divided administratively into 20 local government areas headed by chairpersons assisted by counsellors. All these officers are democratically elected. There are also six traditional (emirate) councils headed by emirs who have a lot of influence over their peoples and are greatly respected.

Nomadic herding and cultivation of groundnuts, beans, corn, and millet are the major occupation of the people in most of the rural areas.[220] The women sometimes help in the farms or in tending the livestock, milking the cows and selling the milk and other farm produce, but mostly they look after the children. Occupations are more varied in urban areas.

Health Sources

The state has three tertiary hospitals, which are located in the two major urban towns, Bauchi and Azare. There are 13 other general hospitals in other towns, and 16 health centres, 132 maternity clinics and several hundred health posts and dispensaries distributed all over the state. There are many private general medical clinics in the state but only one private eye clinic located in the state capital. There are about 250 medical doctors, six of whom are ophthalmologists, in the two major urban centres. There are hundreds of general nurses (42 ophthalmic nurses) and community health workers. There are eight optometrists and three opticians. There are two government hospitals and two private clinics offering cataract and glaucoma and other eye surgeries. The fees paid by patients for cataract and also for glaucoma surgery range from £30- to £100.

The population often also access traditional eye healers and itinerant couchers (mobile traditional healers who treat cataract) for the treatment of their eye problems often with disastrous consequences. Couching is quite common and in many areas is the only eye service available.

Care of glaucoma patients in ATBUTH Bauchi



Figure 8: The researcher examining a glaucoma patient in ATBUTH eye clinic

The following published papers describe the usual care in glaucoma patients in ATBUTH including how service is delivered to patients, medical, surgical and post operative management, the equipment available, and funding. These are:

1. Glaucoma care at ATBUTH Eye Clinic, Bauchi. Abdull MM. *Community Eye Health J.* 2014;27(87).
2. Managing a patient with open-angle glaucoma: a case study; Kyari F, Abdull MM. *Community Eye Health.* 2012;25(79-80):71-2.
3. Medical treatment of open-angle glaucoma; Kyari F, Abdull M, Kiage D, Ogunro A. *Community Eye Health.* 2012;25(79-80):77-9.
4. The basics of good postoperative care after glaucoma surgery. Kyari F, Abdull MM. *Community Eye Health.* 2016;29(94):29-31.

Paper 7: Glaucoma care at ATBUTH Eye Clinic, Bauchi

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RESEARCH PAPER COVER SHEET

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SECTION A – Student Details

Student	Mohammed M Abdull
Principal Supervisor	Clare Gilbert
Thesis Title	Adapted motivational interviewing to improve uptake of treatment in glaucoma patients in Bauchi state, Nigeria

If the Research Paper has previously been published please complete Section B, if not please move to Section C

SECTION B – Paper already published

Where was the work published?	Community Eye Health Journal		
When was the work published?	December 2014		
If the work was published prior to registration for your research degree, give a brief rationale for its inclusion	N/A		
Have you retained the copyright for the work?*	Yes, see appendix 5d	Was the work subject to academic peer review?	Yes

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Where is the work intended to be published?	
Please list the paper's authors in the intended authorship order:	
Stage of publication	

SECTION D – Multi-authored work

For multi-authored work, give full details of your role in the research included in the paper and in the preparation of the paper. (Attach a further sheet if necessary)	
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Student Signature: AS L O

Date: 15 December 2016

Supervisor Signature: Chilant

Date: 15 December 2016

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CASE STUDY: NIGERIA

Glaucoma care at ATBUTH Eye Clinic, Bauchi



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The Abubakar Tafawa Balewa university teaching hospital (ATBUTH) in Bauchi, Nigeria, became a university teaching hospital for Bauchi State in 2010. Interest in glaucoma started in 2009, as many patients presented very late and were blind in one or both eyes.

The hospital has a large, mainly rural, catchment population. Most patients self-refer but referrals from district hospitals – which are staffed by ophthalmic nurses – are increasing. Patients with glaucoma now attend from across northern Nigeria.

Glaucoma services at the hospital is supported by the following six components of the local eye health system (refer also to the article on page 51).

Leadership and governance

The clinic is headed by the author, who also sits on several hospital committees and boards and received specialised training in glaucoma in the UK in 2011. A senior ophthalmic nurse manages the day-to-day running of the clinic, e.g. stock control and ordering.

Human resources for health

The department benefits from frequent locum consultant ophthalmologists, three optometrists, three resident doctors, two medical officers, eight ophthalmic nurses, two community health extension workers (who measure visual acuities), and five records staff. Residents visit to gain surgical experience. To reduce the load on the ophthalmologists, visual field assessment is undertaken by the optometrists, who are assisted by optometry interns.

Three nurses have been trained at the National Eye Centre in Kaduna to assist in theatre. Two doctors have been sent for ophthalmology residency training with plans to send two more. Weekly departmental meetings are held to discuss cases.

Technology, equipment, infrastructure and medicines

The eye department has a reception area for records and fee payment, a large waiting area, space for measuring visual acuity, six offices for consultants, and additional consulting rooms for junior doctors, optometrists and nurses. There is also an operating theatre and a minor procedures room. There is a dedicated room for glaucoma diagnostic equipment, a glaucoma research project office, and a

glaucoma counselling room where motivational interviewing (a type of supportive counselling) is provided by two interviewers.

In 2004, the clinic had only one slit lamp, a Schiotz tonometer, a lens trial set and a loupe. For detection of glaucoma there are now 1-, 2- and 4-mirror gonio lenses, tonometers (Goldmann, airpuff and Perkins), lenses for retinal/disc examination, a stereoscopic digital fundus camera for optic disc imaging and a Twinfield visual field analyser. In 2010, the clinic purchased a diode laser for trans-scleral cycloablation.

The eye clinic stocks some glaucoma medication for patients.

Health financing

The department is funded by the hospital, which runs a revolving fund. This fund works by giving some seed money to the clinic to purchase all the consumables and drugs needed to run the unit. As service is provided, this money is recovered from patients' fees and any profits are used to replenish the revolving fund.

There are three systems for payment: user fees, the National Health Insurance Scheme (NHIS) and retainerships. In retainerships, companies or organisations enter into an agreement with the hospital to treat their staff whenever they need medical attention. These organisations deposit money with the hospital, which is then used to offset any bills incurred by their employees.

There is a social welfare department to assist patients who are unable to pay for services. The hospital finances all staff training, including specialist training, and equipment for eye care is purchased by the hospital, mostly from profits from the revolving fund.

Health information systems

The availability of new clinic space and staff allowed a more organised system of

record keeping to start in 2010: new patients obtain a card to see the ophthalmic nurse or optometrist, and a folder is only opened if consultation with a doctor is required. The system is being made electronic, which is essential for monitoring glaucoma patients.

Service delivery

Optometry interns screen all patients aged ≥ 30 years who attend the clinic for glaucoma using optic disc assessment. All those with suspicious discs are examined in detail. In 2013, glaucoma was diagnosed in more than 500 patients.

Since laser treatment became available (which is explained to patients as computer light treatment), many patients have accepted laser rather than trabeculectomy. Over 300 patients have been treated with laser so far, 160 of whom are being closely followed up. Laser gives good lowering of IOP in the short term and results are being routinely recorded. These data will be published when 1-year follow-up data are available. In 2012, we started a clinical trial to assess the effectiveness of motivational interviewing to increase patients' uptake of laser or trabeculectomy when this is the treatment of choice.¹

A health education pamphlet on glaucoma, suitable for those who are not literate, has been developed.

Conclusion

The support of senior management in the central hospital has been very important in the development of the eye clinic. The commitment of senior management to the eye clinic is the result of several factors:

- eye clinic staff involvement in the management of the central hospital
- building good relationships with people in a position to support the clinic and increasing their awareness of glaucoma
- positive feedback from patients about the high quality care they have received
- prudent management of resources, including the revolving fund.

The clinic needs further strengthening as a tertiary glaucoma centre, including the purchasing of better equipment. Once this has been achieved, secondary level centres in the state will be supported by the clinic to improve their care and referral of glaucoma patients. Our long-term goal is to support early detection and referral of glaucoma at primary eye care level, with effective management of glaucoma at secondary and tertiary levels.



Digital fundus photography for glaucoma screening

Mohammed Abdull



Paper 8: Managing a patient with open-angle glaucoma: a case study

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SECTION B – Paper already published

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When was the work published?	January 2012		
If the work was published prior to registration for your research degree, give a brief rationale for its inclusion	N/A		
Have you retained the copyright for the work?*	Yes, see appendix 5d	Was the work subject to academic peer review?	Yes

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Stage of publication	

SECTION D – Multi-authored work

For multi-authored work, give full details of your role in the research included in the paper and in the preparation of the paper. (Attach a further sheet if necessary)	Provided the case that was studied, participated in the discussion and finally gave the treatment carried out for other authors to comment on
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Student Signature: _____

Date: 15 December 2016

Supervisor Signature: _____

Date: 15 December 2016

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CASE STUDY

Managing a patient with open-angle glaucoma: a case study



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PANEL OF EXPERT GLAUCOMA SPECIALISTS



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Professor of Ophthalmology, University of Cape Town; CBM Eye Medical Advisor.



Dan Kiage

Head of Ophthalmology, Aga Khan University Hospital, Kenya.



Karim F Damji

Professor of Ophthalmology, University of Alberta.



Adeola Onakoya

Consultant Ophthalmologist, College of Medicine, Lagos University Teaching Hospital, Lagos, Nigeria.

Case presentation



Mr AA is a 48-year-old shop attendant who presented at the eye unit of a teaching hospital with a history of gradual, painless vision loss. His presenting

(unaided) visual acuity was counting fingers at 1 metre in the right eye and 6/60 in the left eye. Both corneas were clear, and the pupils had a slow reaction to light. There was a right relative afferent pupillary defect (RAPD). The right eye had a nuclear sclerotic cataract which precluded a good view of the optic nerve head, and a vertical cup:disc ratio (VCDR) of about 0.9, barely visible through the dilated pupil with the binocular indirect ophthalmoscope. The left eye VCDR was 0.8. Intraocular pressure (IOP) was 32 mmHg (right eye) and 30 mmHg (left eye) by applanation tonometry. Gonioscopy showed open angles in both eyes. Visual field tests (standard automated perimetry [SAP]) could not be carried out.

How would the panel manage Mr AA?

Most of the panelists mentioned the importance of talking to Mr AA about glaucoma and what his treatment options

were. Some mentioned asking a nurse counsellor to talk to the patient.

The next important issue to be addressed was the setting of a target IOP in the lower teens, and discussing this target with the patient.

There was general agreement that the initial control of IOP should be by medical treatment, while preparing for surgery on the right eye. First choice was a combination of a beta-blocker and a prostaglandin analogue (PGA). A second option was a combination of a beta-blocker and an alpha-agonist. The panel mentioned the need to bear in mind the cost and availability of the drugs.

All panelists agreed that the right eye should be treated first, and firmly recommended a combined procedure: cataract with posterior chamber intraocular lens (PCIOL), and trabeculectomy with adjunctive antimetabolite therapy. The reasons were both clinical and patient related:

"A trabeculectomy alone may give better IOP control, but will likely worsen vision and, depending on the techniques available and how the bleb turns out, going back to take out the cataract could create inflammation and/or directly compromise the bleb and worsen IOP control."

"Cataract surgery alone is out of the picture, since a serious IOP spike could wipe out remaining visual field and adequate IOP control is not likely to be achieved."

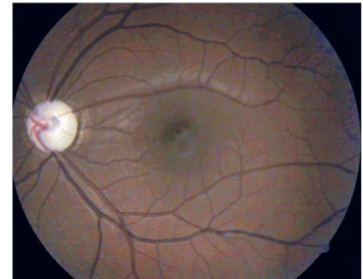
"The patient will better understand the benefit of surgery [and therefore be more likely to attend further appointments] if he can be offered some visual improvement."

Depending on the centre and available facilities, the suggested approaches for surgery on the right eye were:

- phacoemulsification with PCIOL and trabeculectomy
- small incision cataract surgery (SICS) with PCIOL and trabeculectomy at a separate site
- extra-capsular cataract extraction (ECCE) with PCIOL and trabeculectomy.

Adjunct therapy could be with:

- beta irradiation applied with a strontium plaque
- mitomycin C (MMC)
- 5-fluorouracil (5FU).



Fatima Kyari

End-stage glaucoma: disc-cupping

Adjunct therapy is to prevent bleb scarring, however, there is little evidence that MMC or 5FU make any difference in combined procedures.

There is some evidence to support using separate sites rather than the same site in combined phacoemulsification and trabeculectomy surgery.

The choice of treatment for the left eye was not so uniform across the panel. Having initiated medical treatment for IOP control, a top choice was to perform a trabeculectomy with adjunct 5FU or MMC. However, some panelists said they would only offer surgery if there was inadequate IOP control with medications; others would also offer laser treatment as an option.

Both eyes would also have refraction, and the patient would be given spectacles if needed.

Additional comments from panelists

"Patients are becoming more informed and are likely to seek more information and ask for more choices, regardless of their literacy or socioeconomic levels. Therefore, counselling needs to be more comprehensive, to include the biological situation of the eye and whole body, the patient's psychological perceptions, their social and economic situation, as well as their religious beliefs."

"The role of counsellors cannot be overemphasised, as they will take more time to explain to the patient the pros and cons of staying away or declining surgery."

"The nurse counsellor could keep a register with the patient's mobile phone number. She could sms (text) or phone him if he defaults on follow-up."

"When the mode of treatment is certain and options are limited, like in the case of the right eye, then be firm to recommend that to the patient."

Continues overleaf ►

"In the absence of a visual field test machine, assessment can be done very simply, by confrontation visual field testing, with a red pin or fingers [see page 68]. Some people have abnormally large discs, which may seem to indicate pathology, but have normal visual fields."

"If it is not possible to visualise the disc, for example because of cataract, be guided by the patient's IOP and by the results of visual field tests, however basic."

"It is important to carefully assess for RAPD because the disease is asymmetric. In the absence of any other formal function test (such as visual fields) RAPD is a very useful clinical sign in glaucoma, because it provides objective evidence of functional loss [see page 58]."

Full case and management

After the panelists outlined their management plan for Mr AA, they were given the full case and details of the management that was actually undertaken in his presenting hospital.

Mr AA was diagnosed with glaucoma and cataract at his initial presentation. At that time he was told he had advanced eye disease and needed to have surgery to preserve his vision. He asked whether the operation would make him see better. He was frankly informed that it would only preserve the vision he had at that time in the left eye; and that, if the cataract was causing much of the poor vision in the right eye, his vision in that eye would improve after cataract surgery.

Medical treatment with eye drops (xalatan and timolol) was recommended, and Mr AA was given one month to make a decision about surgery. He was told to get the prescribed medications in the meantime and to start using them.

Mr AA did not return until six months later. He said that he had bought one bottle each of the eye drops, but could not buy more because they were expensive. He decided not to come back to the clinic because he was sure the doctor would be angry with him. At that stage he decided to see a traditional healer on the recommendation of a close family friend.

When this did not work, Mr AA went to a different eye clinic near his home where he was told he had cataract and needed to go to hospital for surgery. This brought him back to the same eye unit, where visual field assessment by confrontation was attempted.

This showed substantial loss of his

peripheral visual field: Mr AA was only able to see fingers when they were presented in the centre of his visual axis.

Mr AA was informed that his vision had deteriorated further since the last time he was seen, and that if this continued he would lose vision permanently in both eyes. He was offered combined cataract surgery and trabeculectomy in the right eye, and trabeculectomy only in the left

eye. The right eye would be operated on first.

Surgery, rather than medical treatment, was offered because it was clear from past experience that he would not be able to afford to use the more

effective eye drops on a regular basis: surgery would be a one-time procedure which would be cheaper for him in the long run.

The decision to offer combined trabeculectomy and cataract surgery was made based on the patient's record of defaulting on follow-up. Removal of the cataract from the right eye would provide him with some improvement in vision as well as IOP control, which would hopefully motivate him to present for trabeculectomy in the left eye at a later time.

Mr AA agreed that he would have the operation this time, but said he wanted time to talk to his family about how they could make the money available. As he could not afford xalatan, he was then asked to use only timolol until the surgery date. Pilocarpine, even though less costly, was not an option for him as cataract surgery was being planned.

Mr AA was given two weeks to make a decision and return.

He returned after three weeks, explaining that the person accompanying him had been away. However, he came

prepared to have surgery and was admitted for surgery immediately so as not to lose him.

The standard surgery usually offered at the hospital is manual small-incision sutureless cataract surgery. Mr AA was initially offered right ECCE and PCIOL, because combined SICS and trabeculectomy can be more difficult to perform. However, the final decision was to offer SICS with PCIOL at a temporal site, and simultaneous trabeculectomy with MMC at a more nasal position. The decision to use MMC was to prevent bleb scarring.

Mr AA's immediate post-operative unaided visual acuity in the operated eye was 4/60. He was also informed about the importance of adherence to prescribed medication and follow-up after the operation.

Mr AA returned for his 1-month follow-up appointment and had a post-operative review of the right eye. His unaided visual acuity was 6/60; the bleb was draining and was not cystic; the IOP was 12 mmHg and he was pleased with his improved visual function.

There was some discussion about what to do about the left eye and he was asked to bring his first-degree relatives to the next appointment, so that they could be screened for glaucoma.

Mr AA underwent refraction of the left eye and had a corrected visual acuity of 6/18. IOP was controlled with timolol and xalatan (which Mr AA was able to buy using some of the funds he had set aside for the operation). However, because he expressed concern about not being able to afford life-long medication, left eye trabeculectomy with MMC was subsequently performed.

We are grateful to our reviewers, Clare Gilbert, Richard Wormald, and Nick Astbury for their contributions.

'The uptake of glaucoma surgery still seems very low in Africa'

Final comments by the panellists

"An interesting case and very real in our setting. Mr AA highlights the problem that we all experience: non-compliance with topical medication and failure to return for regular follow-up."

"The ophthalmologist made very reasonable decisions in the light of the prevailing circumstances."

"Even challenging situations can lead to success, as seen in this case, at least in the short term."

"Surgery is definitely the right approach in the management of this patient; otherwise the next time he returns his visual acuity may be further reduced."

"The uptake of glaucoma surgery still

seems very low in Africa. However, we should realise that, for many of our patients, surgery should be the first line of treatment. Nevertheless, there will still be patients who would adamantly refuse surgery, and for whom we would need to consider laser treatment, if available."

"This case underscores the role of advocacy for universal health care to cover potentially blinding conditions such as glaucoma, as well as the need for greater public education and awareness. These are issues which the ophthalmologist cannot handle alone but which require engagement with government and other community development sectors."

Paper 9: Medical treatment of open-angle glaucoma

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SECTION A – Student Details

Student	Mohammed M Abdull
Principal Supervisor	Clare Gilbert
Thesis Title	Adapted motivational interviewing to improve uptake of treatment in glaucoma patients in Bauchi state, Nigeria

If the Research Paper has previously been published please complete Section B, if not please move to Section C

SECTION B – Paper already published

Where was the work published?	Community Eye Health Journal		
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Have you retained the copyright for the work?*	Yes, see appendix 5d	Was the work subject to academic peer review?	Yes

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SECTION C – Prepared for publication, but not yet published

Where is the work intended to be published?	
Please list the paper's authors in the intended authorship order:	
Stage of publication	

SECTION D – Multi-authored work

For multi-authored work, give full details of your role in the research included in the paper and in the preparation of the paper. (Attach a further sheet if necessary)	Jointly drafted and reviewed the with the other author using our experience in glaucoma care in Nigeria
--	---

Student Signature: ASL

Date: 15 December 2016

Supervisor Signature: Gilbert

Date: 15 December 2016

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needling is haemorrhage – either sub-conjunctivally or into the anterior chamber. If your view is obscured, then you should stop and try another time.

A hyphaema requires the patient to be reassured, as their vision will be affected: you should wait until you are sure the active bleeding has stopped. Let the patient rest for 30–60 minutes then check for ongoing haemorrhage and a pressure rise, since the blood can sometime obstruct drainage completely. Once stable, manage the patient as for a hyphaema post-trabeculectomy: discharge the patient and review within one week as appropriate.

The other post-needling complication is hypotony. I personally have only had to take one patient back to theatre for this to date. If the anterior chamber has significantly shallowed, let the patient rest and see if it reforms spontaneously. If it does, then manage the patient as for a low pressure following trabeculectomy. If it does not, then introducing viscoelastic or gas to the anterior chamber is your best option, with regular review as appropriate. Case reports exist of infection and mis-placed needles, but these are fortunately rare (hopefully because appropriate care has been taken by clinicians). Prophylactic topical antibiotics are used by most practitioners. Pre- and post-operative steroids remain a mainstay of therapy to prevent recurrent scarring.

Sub-conjunctival steroid and 5-fluorouracil (5FU) are the most common antiscarring preparations. Be extremely careful that the drugs do not enter the anterior chamber. If they do, wash out in theatre immediately. See page 75 for tips on administration of 5FU. Mitomycin C is being used more frequently, and interferon, sodium hyaluronate, and bevacizumab are amongst the many additional agents that have been reported, with varying success.

If needling is not appropriate or has failed, what subsequent procedure is required?

This depends on all the above factors and what is possible in your unit. Cyclodiode ciliary body ablation, repeat trabeculectomy at a second site, formal revision of the existing trabeculectomy, and drainage tube implantation are the most common options.

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MEDICAL TREATMENT

Medical treatment of open-angle glaucoma



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Most guidelines that exist for the treatment of primary open-angle glaucoma (POAG) – such as the National Institute for Health and Clinical Excellence (NICE) guidelines (page 47) – recommend medicine as initial therapy, though laser treatment may also play a role.

None of these guidelines are based on research done in Africa, however, and there also is no evidence yet on the relative effectiveness of different glaucoma medications in African populations.

For medicines to be effective at controlling POAG, they must be used every day for the remainder of the patient's life.

This means the medicine must not only be clinically effective, it must also be available, of good quality, affordable, and well tolerated by the patient.

Keep the following in mind when choosing medical treatment for your patient.

- 1 **The cost:** can the patient afford the recommended medication in the long term?
- 2 **Availability:** will the drug(s) always be in stock, and what are the consequences to the patient of any stock-outs?
- 3 **Quality:** for drugs such as latanoprost, will the cold chain be maintained? Can the patient refrigerate the medicine? Can the patient recognise and avoid fake drugs?
- 4 **Discomfort:** is there any discomfort associated with the medicine that will discourage the patient from continuing with treatment?
- 5 **Follow-up:** will the patient be able to attend regular follow-up appointments?

'Medicines must be used every day for the rest of the patient's life'

If you have concerns about any of the above, it may be advisable to consider surgery to control intraocular pressure (IOP).

Ongoing monitoring is essential during medical treatment. The NICE guidelines suggest that surgery should be offered if two drugs (or one fixed-combination drug preparation) are not sufficient to control pressure and/or halt disease progression.

Choosing the right drugs

There are five main groups of glaucoma drugs, each acting in a different way to reduce IOP:

- **prostaglandin analogues** (bimatoprost, latanoprost, and travoprost) increase uveoscleral outflow
- **beta-blockers** consist of two main groups: selective (betaxolol) and non-selective (timolol, levobunolol), both of which decrease aqueous production
- **alpha-2 adrenergic agonists** (apraclonidine, brimonidine) decrease aqueous production and increase uveoscleral outflow
- **carbonic anhydrase inhibitors** decrease aqueous formation and can be applied topically (brinzolamide, dorzolamide), or systemically (acetazolamide, methazolamide)
- **parasympathomimetics** (pilocarpine, carbachol) increases aqueous outflow

Continues overleaf



A selection of glaucoma drugs available in Nigeria

through the trabecular meshwork by means of ciliary muscle contraction, and may open the drainage angle in angle-closure glaucoma by stimulating the iris sphincter muscle.

Generally, the recommended first-line drug will be one of the prostaglandin analogues (e.g., latanoprost). These drugs have an IOP lowering effect of 28–33%, require once a day dosing, and have limited local side effects. However, they are expensive and can be difficult to obtain.

Timolol, a beta-blocker, is cheaper and quite effective (an IOP lowering effect of 20–30%), but it has systemic side effects: it worsens obstructive pulmonary diseases, slows heart rate, and lowers blood pressure. Timolol 0.5% is no more effective than 0.25% is, but is much more likely to cause side effects.

If patients require more than one type of medication, use fixed combination drug preparations rather than two separate

bottles. There is no evidence that fixed combinations have better outcomes than using individual drugs. However, using fixed combinations is more convenient, reduces the amount of preservatives that enter the eye, and may make it more likely that patients will continue with their treatment (known as adherence or compliance).

It is not advisable to use two or more combinations in an eye. As mentioned before, if a single combination does not work, NICE guidelines recommend offering surgery to the patient.

Side effects

Each drug has different side effects, so prescribers and patients are advised to read inserted leaflets carefully.

- **Pregnant women** should avoid prostaglandin analogues (which can cause uterine contractions) and carbonic anhydrase inhibitors (which have teratogenic effects).

- **People with asthma** should avoid beta-blockers and parasympathomimetics (which can cause bronchospasm).
- **People with sickle-cell anaemia and/or kidney and liver disease** should avoid carbonic anhydrase inhibitors.
- People with **heart block** which is greater than first degree, and anyone with **chronic obstructive pulmonary disease** and **sinus brachycardia** should avoid beta-blockers.

Useful hints

- 1 Determine a target IOP before starting treatment. IOP with initial single-drug therapy should be reduced by at least 20% from baseline. IOP reduction of less than 10% should be considered as a non-response.
- 2 The treatment goal should include stable optic nerve and nerve fibre layer status, as well as stable visual fields.
- 3 Switching drugs within the prostaglandin analogue class may, upon occasion, provide greater lowering of IOP.
- 4 Pilocarpine is useful in pigmentary glaucoma (PG) and pseudoexfoliation glaucoma (PXE), as it reduces iris movements. It may therefore reduce deposition of exfoliation material or pigment in the trabecular meshwork.
- 5 Topical carbonic anhydrase inhibitors (CAIs) and systemic CAIs are poorly additive with respect to lowering IOP.
- 6 Numerous studies have demonstrated neuroprotection in experimental models of glaucoma or optic nerve injury, but good evidence demonstrating neuroprotection in clinical studies is lacking.
- 7 There is insufficient evidence for neuroprotection by alpha-2 adrenergic agonists in humans.

Patient's adherence to treatment may be encouraged and monitored by:

- Educating and counselling the patient
- Training personnel to teach patients and their carers
- Explaining the possible side effects of each drug
- Teaching the patient to record the drugs used and instilled (page 79)
- Checking the patient's drugs at each clinic visit
- Prescribing combination drug preparations, where available, rather than many single preparations
- Giving advice to patients on how to instil eyedrops, particularly if they have any physical impairments, including visual impairment.

Further reading

Kiagi DO, Dami FK. Primary Open Angle Glaucoma: Setting Target Intraocular Pressure Range and Update on Use of Glaucoma Medications in East Africa. *E Afr J Ophthalmol*. 2008 May; 14(1): 60–71.

How to avoid fake glaucoma drugs: top tips

- Buy drugs from registered pharmacies
- Look out for the national drug administration/agency licensing number in your country.
- Check the manufacturing and expiry dates of drugs and be sure that these have not been altered on the packet.
- Many companies now have holograms of their logos on the packet, look for that.
- Some drug companies provide a means for patients to check the authenticity of their medicines. For example, many drug companies in Nigeria put a unique code or number on each box or bottle. Patients can SMS this free of charge to the phone number provided and the drug company will confirm whether the drug is registered and therefore genuine. This facility should be used where available
- Do not buy drugs from hawkers. Apart from raising doubts about the drug's authenticity, hawkers will not be able to store the drugs in the correct conditions. Poor storage, heat, and sunshine will decrease the potency.
- Never accept any drug package without a

company label from the manufacturer (some people peel off the label and write the dosage on the bottle to hide the identity of the medication).

- If not sure of your medication, bring it to the hospital for it to be checked and confirmed.
- Be careful with expensive imported brands from big, well-known drug companies; they are more likely to be fake than locally produced drugs from smaller companies
- Ideally, eye care facilities should stock genuine drugs in good quantities and at reasonable prices. This will help ensure that patients have access to the medicines they need from a trusted source.



It is vital to educate patients about fake drugs and how to avoid them. Fake drugs waste money and can cost patients their sight. NIGERIA

Instilling your own eye drops

- If you have just been prescribed eye drops, make sure someone has shown you how to instil them. Do not leave the eye clinic until you know what to do. Make sure you have had time to practice under supervision.
- Keep this handout safe for future reference.
- Instilling your own eye drops is not easy at first, but your skill will develop as you practice. You will find a technique that works well for you but there are some points that are very important (shown in **bold**).
- If, after much practice, you are still struggling, ask a family member or carer to instil the eye drops for you.
- You may think it will help to use a mirror and some people may even advise this. In fact, the use of a mirror only complicates matters and can even create a dangerous technique. **Avoid the use of a mirror!**
- Eye drops are dispensed in various containers: a bottle (plastic or glass) with a removable dropper and combined cap; a plastic bottle with dropper attached and removable cap; or a glass bottle with plastic pipette attachment and removable cap. Whatever type is given to you, **do not touch the part from which the drop falls**.
- Before instilling eye drops, **wash your hands thoroughly**, and afterwards too.

How to instil your own eye drops

- 1 Sit or lie down with your head supported. As your skill develops you may eventually manage to instil your eye drops while standing.
- 2 Use your dominant hand to hold the bottle/dropper/pipette
- 3 With the index finger of your other hand, hold a clean piece of tissue or cotton wool, and **gently** pull down the lower eyelid to form a 'pocket'.
- 4 Hold the bottle/dropper/pipette between your thumb and forefinger, and place the 'heel' of your hand (where



Everybody develops their own technique that works for them

the wrist meets the hand) on your cheek. This will help to steady shaky hands.

- 5 Make sure there is a distance of about an inch (2.5 cm) between your eye and the end of the bottle/dropper/pipette. **Be careful – the tip must not touch any part of the eye or eyelids.**
- 6 Look up or to the side. **Do not look directly at the bottle/dropper/pipette.**
- 7 Squeeze the bottle/dropper/pipette – allow **one drop** to fall into the lid pocket.
- 8 Slowly let go of the lower lid. **Gently** close your eyes; try not to shut them tightly as this will squeeze the drop out of your eye.
- 9 Dab your closed eye with the tissue or cotton wool to remove any excess.
- 10 Put gentle pressure on the inside corner of your eye and count to 60, very slowly. This prevents the medicine from draining out of your eye before it is absorbed.

A few more top tips

General

- Store eye drops in a cold place, if possible in a refrigerator. It is easier to feel a cold drop going in; this will reassure you that your technique is good.
- If you struggle to hold a small bottle/dropper/pipette, wrap something like a folded piece of tissue around it.
- Wait at least 5 minutes between inserting different types of eye drops.
- Instil eye drops first, then eye ointment (if prescribed).

Glaucoma patients

- Instil your drops at regular intervals throughout the day. This is vital in controlling the intraocular pressure.
- Create a form or 'tick sheet' you can fill in when you have taken your drops (see Table 1).
- It is important to learn to instil your own drops. Medication for glaucoma is usually needed for the long term.
- Practice makes perfect!

Table 1. Sample patient record of eye drops instilled, for someone who has to instil eye drops four times a day.

Medication	Eye (left eye, right eye, both eyes?)	Breakfast/sunrise	Lunch/midday	Evening/sunset	Bedtime

Paper 10. The basics of good post operative care after glaucoma surgery*

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Student	Mohammed M Abdull
Principal Supervisor	Clare Gilbert
Thesis Title	Adapted motivational interviewing to improve uptake of treatment in glaucoma patients in Bauchi state, Nigeria

If the Research Paper has previously been published please complete Section B, if not please move to Section C

SECTION B – Paper already published

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Please list the paper's authors in the intended authorship order:	
Stage of publication	

SECTION D – Multi-authored work

For multi-authored work, give full details of your role in the research included in the paper and in the preparation of the paper. (Attach a further sheet if necessary)	Jointly drafted and reviewed the article with the other author based mostly on our experience managing glaucoma patients in Nigeria.
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Student Signature:

AS 20

Date: 15 December 2016

Supervisor Signature:

CG

Date: 15 December 2016

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Cystoid macular oedema (CMO) is often the cause of unexpected visual loss and may become evident 4-6 weeks after surgery. It is more likely if the operation has been complicated, or there is diabetic retinopathy or pre-existing macular scarring. The majority of cases resolve spontaneously over weeks or months but with some loss of contrast sensitivity or, more significantly, poor vision. CMO is often treated with topical/sub-Tenon's or intravitreal steroids or non-steroidal anti-inflammatory drops. Surgical intervention is called for when there is an identifiable provoking cause, for example a vitreous wick, retained lens fragments or a decentred intraocular lens. As a precaution, most patients suffering from diabetic retinopathy or epiretinal membranes (pre-existing scarring at the macula) should be given anti-inflammatory medication as prophylactic treatment after their operation. The symptoms are blurred or decreased central vision.

Retinal detachment may occur weeks or months after surgery, more commonly in highly myopic people or after complicated surgery with vitreous loss. The symptoms may include 'flashes and floaters' and a peripheral 'shadow' across the vision. Refer immediately.

Posterior capsular opacification (PCO) (Figure 3) occurs in 10% of patients after two years and is the commonest reason for further intervention after cataract surgery. It is caused by lens epithelial cells migrating across the (normally clear) posterior capsule of the lens. It is treated with Nd-YAG laser in the eye clinic. In young people and children, opacification can occur early and patients should be warned that this may occur. The symptoms are blurred vision and glare.

Conclusion

The end of the operation is the beginning of an anxious period for the patient, when they are hoping that their sight will be restored. If complications have occurred the patient must be kept informed and the outlook must be explained to them. Postoperative symptoms should be heeded and signs carefully looked for in case intervention is required. Good preoperative counselling and awareness of postoperative problems will help to ensure that complications are detected early and managed effectively.

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1. Alshihy AM (2014) Epidemiology of postoperative endophthalmitis (POE) in a specialized eye hospital. *Epidemiol* 4:145. doi: 10.4172/2161-1165.1000145.

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GLAUCOMA

The basics of good postoperative care after glaucoma surgery



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Glaucoma patients are treated by lowering the intraocular pressure (IOP) to a level that it is not harmful to the optic nerve. This prevents or delays loss of vision. Lowering of the IOP can be achieved through use of eye medication, surgery or laser procedures. The most common glaucoma surgery is trabeculectomy. This entails creating an additional passage for the drainage of the fluid inside the eye (the aqueous humour). The fluid drains from the anterior chamber, through an opening (fistula) in the sclera, to an artificially created reservoir (the bleb) under the conjunctiva. The bleb enables the fluid to be absorbed gradually into the systemic circulation and is hidden under the eyelid.

Before patients have a trabeculectomy, they must be informed that the operation will not cure the disease; it will lower the IOP in order to reduce the rate of deterioration of vision loss. They must understand that any vision already lost cannot be regained through surgery and that the surgery may cause

initial blurring of vision in the immediate postoperative period (and will resolve by itself over time).

Good follow-up care is essential, and patients should be provided with a contact number to call when they need to complain, ask for information or reschedule an appointment, or when they notice any symptoms that could indicate a complication.

Postoperative care after trabeculectomy can be classified into immediate postoperative care (0-6 weeks) and mid- to longer-term postoperative care (after 6 weeks).

Principles of immediate postoperative care (0-6 weeks)

Ensure that the aim of surgery has been achieved, i.e. that the IOP has been lowered

One day after the operation (on day 1), the surgeon examines the eye to ensure that the operation is achieving drainage of aqueous humour with adequate formation of a bleb and satisfactory lowering of the IOP. The IOP on the first day postoperatively is not the final IOP, but serves as a good indication that a drainage channel has been successfully created. The surgeon also examines the eye to look for early complications at this stage: infection, hyphaema, conjunctival/wound leak, shallow/flat anterior

Continues overleaf ➤



Patients wait for their follow-up examination, which will include IOP measurement – an essential component of postoperative glaucoma care. NIGERIA

chamber, hypotony requiring intervention, and choroidal detachment.

Protect the eye from external injury

The operated eye is padded until the following day. If the other eye has no vision, the operated eye is not covered but a perforated eye shield is placed on it instead.

Ensure hygiene and prevent infection

The patient should keep the face clean and avoid touching the eye. Patients may bathe and shower, taking extra care not to bend forward or to touch the operated eye (which may also be protected with an eye shield). Hands should be washed before instilling any eye drops. Postoperative antibiotic eye drops (e.g. chloramphenicol) are prescribed for use 4–6 hourly or 4–6 times a day for 2–3 months.

Reduce inflammation associated with the operation

Some degree of redness and swelling may occur after the operation. Postoperative anti-inflammatory eye drops (e.g. dexamethasone) are prescribed for use 1–2 hourly during the first few days and subsequently reduced to 4–6 times a day. The postoperative eye drops may be used for 2–3 months as advised by the reviewing doctor.

Control pain

It is usual to have some eye pain after glaucoma surgery but this is often mild and responds to analgesics such as non-steroidal anti-inflammatory drugs and acetaminophen.

Symptoms and signs of complications (0–6 weeks)

A sudden loss of vision

A small reduction in vision, usually not more than 2 lines of visual acuity (VA), may occur after surgery, but should improve gradually or at least not worsen rapidly. Rapid deterioration of vision is an emergency; therefore it must be reported promptly. The following are common causes.

- 1 **A hyphaema** indicates the presence of blood in the anterior chamber. This clogs the trabecular meshwork and blocks the fistula created for drainage to the sub-conjunctival space, causing the IOP to rise, sometimes catastrophically. This increases damage to an already diseased optic nerve and may result in blindness if not promptly reported and treated. Patients should report to the health facility where they had the surgery for urgent management.



After a trabeculectomy, eyes require special care and protection from injury, e.g. wearing UVB sunglasses during the daytime. KENYA

Sudden loss of central vision may occur, especially in patients who had very severe disease at the time of surgery. Surgeons sometimes make a decision to avoid operating on such patients but instead offer other, less invasive, alternatives. Vision loss may be gradual or rapid, depending on the severity of disease and postoperative inflammation.

- 2 **Choroidal detachment** is caused by the passage of serum into the supra-choroidal space (between the sclera and the choroid) due to increased transscleral pressure, most frequently caused by globe hypotony following trabeculectomy. It can present with quite severe loss of vision with variable degrees of pain. An urgent B-scan ultrasound can help with the diagnosis. Urgent treatment is needed to prevent permanent loss of vision.

Soft eye

This leads to a shallow or flat anterior chamber. It is usually caused by over-filtration due to a loose scleral trabeculectomy flap, a conjunctival wound leak at the incision site, or a leak via a conjunctival buttonhole. It may or may not present with reduction in vision, with little to severe pain depending on the cause. Padding the eye may be sufficient, but urgent surgery is sometimes necessary.

Redness, pain and discharge (pus)

This may be accompanied by a possible drop in VA very soon after surgery, and this combination is usually indicative of an active infection. Redness alone may be normal following surgery but if it persists beyond a few days it should be reported

as it may mean an active inflammation in the eye. All instances of the above symptoms should be reported urgently to the health facility where they will be investigated and properly treated.

Principles of longer-term postoperative care (after 6 weeks)

Optimise vision

Six to eight weeks after the operation, refraction should be undertaken to assess the patient's best-corrected visual acuity (BCVA) and to obtain a prescription for spectacle or contact lens correction. Not everyone can wear/continue with contact lenses following trabeculectomy. The doctor must assess the bleb and the suitability of contact lens wear.

Continue to protect the eye

Advise the patient about protecting their eye. Especially in sports, physical contact activity and windy weather, the eye needs to be protected from injury with sports goggles (where indicated) or UVB sunglasses during outdoor activities such as riding a motorcycle. The protective eyewear should be kept clean.

Continue medication

When necessary, the postoperative medication (antibiotics and steroid eye drops) may be continued for up to 3 months after surgery on advice of the doctor.

In some cases, anti-glaucoma medication may also be prescribed after the operation, if the lowering of the IOP to the desired level has not been achieved. Patients should be made aware of this possibility before surgery.

Be alert for signs of postoperative complications

The patient must be monitored regularly to detect any changes in vision, pain or any other symptoms that will indicate postoperative complications such as infection, a failed bleb or overfiltration. The importance of community-based follow-up by the community health worker or ophthalmic nurse cannot be overemphasised; this is essential in order to ensure that symptoms and signs are recognised and treatment offered without delay. Patients should be advised to get help if they notice any symptoms – see panel below.

Possibility of additional surgical procedures

When the IOP control is not at the desired level, the doctor may advise additional procedures to optimise IOP control. These procedures may include the release of releasable sutures, bleb revision, antimetabolite injections or even laser procedures.

'The importance of community-based follow-up by the community health worker or ophthalmic nurse cannot be overemphasised'

Symptoms and signs of complications in the longer term (after 6 weeks)

1 Redness associated with discharge (pus) from the eye.

Long after a successful trabeculectomy, bacterial infection could occur. A

person who has had eye surgery and has discharge (pus) from the eye needs to be seen immediately by an eye doctor and treated with the appropriate medication. Self-medication, especially with steroid eye drops, must be avoided. Serious consequences and loss of vision could

occur if there is endophthalmitis.

2 Discomfort. A large drainage bleb may cause abnormalities in tear spread over the cornea, causing poor tear films that cause a sensation of dryness and discomfort. Such large blebs may also be uncomfortable under the eyelid causing cosmetic embarrassment.

3 Cloudy vision and cataract. The chance of an eye developing a cataract increases after trabeculectomy. The patient should be made aware of this. The patient may have increasing glare in bright sunlight or while driving at night. Any reduction in vision must be investigated to determine the immediate cause. Vision generally improves following cataract surgery, except if the glaucoma damage is significant.

4 Changes in refraction: There may be astigmatism following trabeculectomy because of the mild distortion of the eye's anatomy. This may manifest as a need for new spectacles. Such change can be delayed until about 3 months after the operation, when the eye has stabilised.

5 Continued loss of vision: Even with good IOP control, patients may still continue to lose vision. The patient may see haloes around light bulbs which may indicate cloudiness of the cornea due to raised IOP. Glaucoma surgery reduces the rate of loss of vision in glaucoma patients but may not completely halt it.

Advice for patients at discharge

Patients should be given information about the following before they go home after a trabeculectomy. They should also understand about the possible complications and understand the importance of getting help urgently so that their vision can be preserved. Make sure that patients have the contact information they need, e.g. the telephone numbers of the appropriate person so that they can get an appointment as soon as possible.

How the eye will feel

You may have some watering, sandy sensation or blurring of vision after trabeculectomy, but this should clear within a few days. Soreness and irritation may occur from the sutures or because of the surgery itself. These sensations generally reduce within a few days.

Protection

The eye has now been operated on and is more fragile than before. It is important to take special care and to protect your eye from injury. You can wear UVB sunglasses in the daytime.

Caution with activity

Physical activities that require bending forward such as farming, 'ruku' and

'sajda' (prostration) during Muslim prayer and lifting of heavy items are to be avoided in the first six weeks after surgery. Strenuous activities such as running, jumping, swimming and sex are also to be avoided until the eye doctor advises it is safe to resume them.

Cleanliness and hygiene

- You can shower, have a bath or wash your face to ensure cleanliness.
- For at least one week, do not use eye make-up, including kohl and eye pencil.
- Avoid touching the eye directly or rubbing it.

Medication

- Wash hands before applying your eye drops.
- Do not touch the tip of the dropper of the eye drop bottle with fingers and do not allow the tip of the bottle to touch the eye
- Use the eye drops as often as indicated on the bottle or as directed by your doctor.

Keeping appointments

It is important to keep your appointment, as the eye doctor will need to regularly monitor your vision and eye pressure

and look out for any signs of complications. Bring your eye drops with you to the hospital.

IMPORTANT: Come back in case of any worrying signs or symptoms

Contact your community health worker (if you have one) or your eye nurse or eye doctor immediately if you experience any of the signs or symptoms listed below – even if this is several months after the operation – as these can indicate that there is a problem that needs to be looked at. Coming back quickly will give medical professionals the best chance to save your sight and your eye.

- Any pain: come back very urgently
- A rapid reduction in vision (particularly central vision): come back very urgently
- Redness and/or discharge (pus): come back very urgently
- Haloes around light bulbs: come back very urgently
- Blurry or distorted vision (including increased glare in sunlight or while driving at night): less urgent, but can easily be corrected with a cataract operation or a new spectacle prescription.

* use of sunglasses post surgery or laser therapy is not evidence based

Chapter 5: Trial – Primary outcomes Rationale, Aims and Objectives of the trial



Figure 9: Recruitment of patient in progress. Thumb printing on consent sheet to indicate consent to participate.

Rationale

Glaucoma is a major problem in Africa with the prevalence of blindness being higher than in other regions. There are unique factors that make it particular problem in Africa including early onset of the disease, an aggressive course, and late presentation on account of lack of primary eye care and awareness. Poor facilities and equipment for diagnosis and treatment lead to limited treatment options. There is poor acceptance of and adherence to treatment and higher risk of surgical or medical treatment failure. Some of these factors are not modifiable. For prevention of blindness in glaucoma, research has shown that the outlook can be improved via an intervention aimed at changing the modifiable factors such as increasing in awareness and encouraging behaviour change for acceptance and adherence to treatment and follow up. Many techniques and tools have been used around the world to achieve this. But these may not necessarily apply in the population being studied where levels of education are low, a proportion of the population are very poor, and where eye care services are often far away from communities. Therefore there is a need to develop and test a locally adaptable counselling tool and a suitable delivery method. This research therefore aims to develop such a tool and test it in a randomised controlled clinical trial.

One of the barriers to access in glaucoma care in Africa is limited availability of equipment and thus treatment options are limited. To create more options for the patients a suitable reliable and sustainable procedure needed to be identified. Diode laser cyclophotoablation fitted these criteria. Although transscleral diode laser cyclophotocoagulation has been used in black people around the world, more data were needed about the safety and effectiveness of the procedure. This study therefore also aimed to develop a prospective case series of patients undergoing this form of laser treatment.

Hypothesis

The hypothesis explored in this trial was that patient counselling, delivered by a trained glaucoma educator, will increase acceptance of surgery.

Aims and Objectives

Aim

To assess whether a locally adapted counselling intervention about glaucoma and its treatment has an impact on acceptance of surgery among glaucoma patients in Bauchi state Nigeria.

Specific objectives included in the PhD

1. To determine if a locally adapted counseling intervention has an impact on acceptance of surgery in glaucoma patients.
2. To assess control of IOP in a series of patients treated with diode laser transscleral cyclophotoablation (this series includes patients not recruited in trial)

Trial objectives not included in the PhD as data collection and analyses are on going:

1. To determine the impact of counseling intervention on adherence to topical glaucoma medication
2. To determine the impact of counseling intervention on follow-up in treated glaucoma patients.
3. To determine the impact of counseling intervention on IOP control in treated patients with moderate/advanced glaucoma.

Methods and Results

As the delivery of the health education / behaviour change intervention was motivational interviewing. Before MI sessions could be delivered an interview guide was required which was based on available glaucoma leaflets from other places and what patients currently know and do about glaucoma, their perceptions of the disease and its treatment, and the barriers they faced in accepting and adhering to glaucoma treatment.

Intervention development

Several techniques have been used to develop interventions for patient education and to create content for counselling. Most have used the existing literature to develop the baseline while doing participatory research through focus group discussions (FGDs) and indepth interviews to ascertain patients' perspectives. Often, FGDs include health care providers. Interventions have been developed this way for a range of medical issues or chronic disorders such as psoriasis[221], and childhood obesity.[222] The interventions aim to develop educational materials such as pamphlets,[223] text messaging for hypertension drug adherence,[224] videos or content to guide counselling. Carers are often involved because they have great influence on patient management.

METHODS

Development of the intervention involved three phases:

Phase 1: Qualitative research

Phase 2: A workshop to integrate lay understandings of glaucoma and gaps in patient's knowledge with existing literature in order to develop a locally relevant educational draft in the form of an interview guide

Phase 3: The content of the interview guide was pilot tested among newly diagnosed, literate glaucoma patients

Phase 1

The purpose of the qualitative research was to assess awareness and patients' perceptions of what glaucoma is and how they have managed their problems.

The interviews were designed to follow the general pattern of the new proposed framework for behavioural diagnosis, modified as necessary to ensure all important elements were covered, using additional questions used in other studies.[149, 183, 225]

The methods, participant groups and findings are presented in the paper "Glaucoma, "the silent thief of sight": patients' perspectives and health seeking behaviour in Bauchi, northern Nigeria".

Phase 2:

A workshop was held to integrate lay understandings of glaucoma with existing literature in order to develop a locally relevant counselling draft, called “The silent thief”. Participants included health educators from the ATBUTH, the researcher, a social scientist and note-taker, ophthalmic nurses, personnel from local radio and TV stations, glaucoma patients and their carers and “lay people” without glaucoma.

The researcher gave a short introduction about the challenges of managing glaucoma in the locality. Patient education materials about glaucoma from institutions in Nigeria and abroad, including some in the local Hausa language developed in another institution, were presented for discussion. Participants were asked to analyse the content of the existing pamphlets and list the essential information glaucoma patients need to know, formulated as a series of questions and answers. The group reviewed the materials and summarised their key messages. Then key findings from the FGD and interviews were presented and matched with the summaries and modified as appropriate to reflect the local levels of literacy and culture. Following an agreement on the content, participants were asked to use phraseology and expressions (in the Hausa language) derived from the qualitative research to address each of the questions and refine them, with answers reflecting the local dialect, including common slang terms to aid understanding.



Figure 10: Workshop to design the counseling draft for use in MI sessions.

Phase 3:

In phase three the content of the interview guide was pilot tested among newly diagnosed literate glaucoma patients. They were given a copy of the draft to read prior to the interview. Twenty interviews were conducted which were recorded and analysed. The findings were used to check and amend the language without compromising the content or the quality of the draft. Most patients agreed that one on one counselling with a health worker would be the best way to inform them about glaucoma.

Clinicians reviewed the English translation of the draft locally and at LSHTM for content. The final version of the counselling guide for use in MI sessions in the trial – The Silent Thief - is shown below.

GLAUCOMA COUNSELLING GUIDE FOR MI SESSIONS – The silent thief of sight

What is glaucoma?

- Glaucoma is a disease that causes damage to the nerve that is responsible for transmitting visual impulses from the eye to the brain. Many people do not know about the disease.

What causes glaucoma?

The cause of glaucoma is mostly not known, but it is known to be more common in the following

- People with family history of the disease
- People over 40 years old
- People using glasses for distance vision
- People with hypertension or diabetes
- People using steroids
- Some types of eye trauma
- Glaucoma is not caused by Black fly, anger or annoyance, cold, firewood smoke, dust, wind, excessive crying or evil spirits. Glaucoma is not infectious, so you cannot infect people around you.

How does glaucoma cause blindness?

- The amount of fluid in the eye that maintains the pressure is normally well controlled. Sometimes the pressure becomes high and causes damage to the nerve of the eye. This damage is what leads to irreversible blindness.

Who is affected by glaucoma?

- Glaucoma can affect people of any age, but it is more common in people over 35 years of age.

How does glaucoma present?

- Glaucoma doesn't usually present with pain except in few cases.
- There is a gradual constriction of your peripheral vision
- With time you can only see what is directly ahead of you not to the side
- You may have blurring of vision later on
- You may see rainbow pattern around light

Is glaucoma treatable?

- Glaucoma can be treated to prevent worsening of vision if we present early, but lost vision cannot be recovered.

How is glaucoma treated?

- Using eye drops or tablets. There are different medications (drops or tablets) used to treat glaucoma. Once treatment is started it should not be stopped except on doctor's instruction.
- There is also surgery for controlling glaucoma. Many people are afraid of surgery for glaucoma, but there is nothing to fear as the surgery is effective in controlling the disease and many people have had successful surgeries that have controlled their disease.
- There is also another type of treatment called LASER, which is also effective in controlling the disease.

More on treatment for glaucoma

- Traditional eye medication and similar treatments do not control glaucoma and tend to cause a delay in seeking for treatment, a delay that may lead to blindness. Most traditional medicines used have no measure of dose, one medication is used for many diseases, and because the native doctors are mostly itinerant, if you have a problem you have no one to complain to. In addition to all this, they have no equipment to examine your eye.
- Having eye surgery is cheaper in the long run than using eye drops, because eye drops have to be continued for life.

- Glaucoma medication is not the type of medication that you use now and get immediate relief. It has to be used for a long time to achieve control. You don't stop using your medication because you feel better or you don't only use your medication when you are not feeling better.
- You are required to continue using your medication even if in your opinion your vision is not improving.
- If you stop your medication, even the little vision you have may be extinguished.
- You should find ways to remind you to use your medication on time.
- If you have a problem with the medication, don't stop using it. Inform your doctor who may change it for you.
- Remember, even if the eye is a non-seeing eye, do not stop instilling your drops. Stopping may cause an even worse problem in that eye, such as pain so severe that you feel like plucking out the eye.

What will happen if glaucoma is not treated?

- Untreated glaucoma leads to deterioration in vision and eventually irreversible blindness.

How can we avoid blindness from glaucoma?

- By not missing our regular appointment once we have been diagnosed with glaucoma and placed on treatment.
- By following the instructions of your health worker with regards to regular hospital follow up and use of medication.
- The advantage of discovering glaucoma early is freedom from irreversible blindness.

What should one do if diagnosed with glaucoma?

- Do not miss your regular follow up.
- Do not skip medication times
- Do not be afraid to have surgery if it is recommended by your doctor.

Will I continue to use glaucoma medication after surgery for glaucoma?

- You will have to use medication on the eye till it is healed. Sometimes anti glaucoma medication will still continue even after surgery on doctor's instruction.

NOTE

- Early screening can prevent blindness from glaucoma. Therefore visit the nearest eye hospital at least once a year.
- Let improvements in your sight not stop you from continuing your follow up as instructed to do.
- Let problems with health workers not stop you from coming to hospital. If you have any problem with a health worker, report to the head of department.
- Let some other medical problems not stop your medication and follow up.
- Remember looking after your eye problem will bring you acceptance from your family, continuation of your daily activities, and prosperity in your business and life dealings.
- Family and friends will not avoid you because you are not a burden on them if you seek treatment for glaucoma.
- Finally, do not allow glaucoma to kill your dreams and ambition.

Differentiating between glaucoma and cataract to aid early diagnosis and treatment of glaucoma before blindness.

There is widespread confusion between glaucoma and cataract in the study area, an important difference being that excellent vision can be restored in individuals who are cataract blind by an inexpensive operation, which is not the case with vision loss from glaucoma. To help their understanding and differentiation of the two conditions, a poster was designed to show the differences between the two, which was based on what patients with glaucoma and cataract perceive and how their eyes appear to others. The poster indicated what patients should do if they noticed that their vision is reducing. It is published in the centre of the journal so that it can be detached and used.

Paper 11: What is wrong with my vision, and what can I do?

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RESEARCH PAPER COVER SHEET

PLEASE NOTE THAT A COVER SHEET MUST BE COMPLETED FOR EACH RESEARCH PAPER INCLUDED IN A THESIS.

SECTION A – Student Details

Student	Mohammed M Abdull
Principal Supervisor	Clare Gilbert
Thesis Title	Adapted motivational interviewing to improve uptake of treatment in glaucoma patients in Bauchi state, Nigeria

If the Research Paper has previously been published please complete Section B, if not please move to Section C

SECTION B – Paper already published

Where was the work published?	Community Eye Health Journal		
When was the work published?	January 2012		
If the work was published prior to registration for your research degree, give a brief rationale for its inclusion	N/A		
Have you retained the copyright for the work?*	Yes, see appendix 5d	Was the work subject to academic peer review?	Yes

**If yes, please attach evidence of retention. If no, or if the work is being included in its published format, please attach evidence of permission from the copyright holder (publisher or other author) to include this work.*

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Where is the work intended to be published?	
Please list the paper's authors in the intended authorship order:	
Stage of publication	

SECTION D – Multi-authored work

For multi-authored work, give full details of your role in the research included in the paper and in the preparation of the paper. (Attach a further sheet if necessary)	Provided all the photographs and photo edited them to simulate visual loss. Wrote the accompanying text in consultation with the editor.
--	--

Student Signature: _____

Date: 15 December 2016






Supervisor Signature: _____

Date: 15 December 2016

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What is wrong with my vision, and what can I do?

No eye disease	Glaucoma or 'black blindness'	Cataract or 'white blindness'
 <p>Normal vision</p>	 <p>Seeing only what is in front, not what is above, below, or on either side</p>	 <p>Seeing things as if looking through smoke, mist, or clouds</p>
<p>Appearance of the eye to others</p>	 <p>Normal black appearance of pupil</p>	 <p>White appearance of pupil</p>
Cataract		
<p>What can I notice/feel?</p>	<p>Nothing initially, not even pain. You may often bump into things, or fall over objects on the ground, because you are losing the outer edges of your vision</p>	<p>Gradual clouding of the vision until the vision has almost gone. No pain. Usually in both eyes</p>
<p>Who is at risk?</p>	<p>People who are 40 years of age or older People with a relative who has glaucoma – a parent, sister or brother, or older child People who wear spectacles to see distant objects, who have had an eye injury before, or who use steroid eye drops.</p>	<p>People who are 40 years of age or older People with a previous eye injury People with diabetes People who use steroid eye drops or tablets</p>

Can other family members be affected?	Yes! Glaucoma can run in the family	Cataract does not run in the family, but other older family members may also develop cataract
How urgently do I need to get help?	Very urgently!	As soon as possible
What happens if I wait a long time before being treated?	You may lose your sight, and you will be unable to get it back	It is very likely that you will regain vision
What treatment options do I have?	Vision can be preserved by lowering eye pressure with eye drops, an operation, laser treatment, or a combination of these options	Vision can be restored with a cataract operation and an artificial lens implant
What long-term treatment may I need?	Continued use of eye drops or monitoring after the operation or laser treatment at an eye clinic	Usually none. You may need to wear spectacles after the operation
What are the costs?	Medical treatment: the lifetime cost of eye drops An operation or laser treatment: the cost of an operation and possibly some medication afterwards	One-time cost of the cataract operation
What are the risks of treatment?	Very few side effects of eye drops. Surgery can have complications, but these can be managed at the eye clinic	Highly successful operation with very few or no complications
What will happen if I stick to my treatment and/or say yes to an operation?	Your vision will be preserved – you will still be able to see as you did before It will take a lot longer before you go blind, if you go blind at all	Your vision will be better than before
What happens if I do not accept treatment?	Your vision will gradually worsen and eventually you will become completely blind. This vision is lost forever and can never come back!	Your vision will gradually worsen until you become completely blind. But, at any time, accepting a cataract operation will restore your sight
Will traditional medicine help me?	No. Delay in obtaining the correct treatment means you are likely to lose even more vision	No. Traditional treatment - known as 'couching' (pushing a needle into the eye), can have very serious complications and is not recommended. Eye medication from traditional healers cannot restore sight
What can I do?	Report to the nearest eye clinic urgently to be examined. If you think a relative may have glaucoma advise them to do the same	Report to the nearest eye clinic to be examined. If you know someone who may have cataracts advise them to do the same

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Protocol of the trial of adapted motivational interviewing

The following paper gives a detailed description of the methodology and analysis plan for the clinical trial of adapted MI, which was designed to improve acceptance of surgery or laser among patients with glaucoma attending ATBUTH, Nigeria.

1. Adapted motivational interviewing to improve the uptake of treatment for glaucoma in Nigeria: study protocol for a randomized controlled trial. Abdull MM, Gilbert C, McCambridge J, Evans J. *Trials*. 2014;15(1):149.



Figure 11: An interviewer conducting motivational interviewing with a male patient in a quiet room in ATBUTH eye clinic

Paper 12: Adapted motivational interviewing to improve the uptake of treatment for glaucoma in Nigeria: study protocol for a randomized controlled trial

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Thesis Title	Adapted motivational interviewing to improve uptake of treatment in glaucoma patients in Bauchi state, Nigeria

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SECTION B – Paper already published

Where was the work published?	Trials		
When was the work published?	April 2014		
If the work was published prior to registration for your research degree, give a brief rationale for its inclusion	N/A		
Have you retained the copyright for the work?*	Yes, see appendix 5e	Was the work subject to academic peer review?	Yes

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SECTION C – Prepared for publication, but not yet published

Where is the work intended to be published?	
Please list the paper's authors in the intended authorship order:	
Stage of publication	

SECTION D – Multi-authored work

For multi-authored work, give full details of your role in the research included in the paper and in the preparation of the paper. (Attach a further sheet if necessary)	Did the literature search, planned the study in consultation with other authors, did the field work, drafted the paper, considered and accepted revisions and comments from other authors
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Student Signature: _____

Date: 15 December 2016

Supervisor Signature: _____

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This Provisional PDF corresponds to the article as it appeared upon acceptance. Fully formatted PDF and full text (HTML) versions will be made available soon.

Adapted motivational interviewing to improve the uptake of treatment for glaucoma in Nigeria: study protocol for a randomized controlled trial

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Adapted motivational interviewing to improve the uptake of treatment for glaucoma in Nigeria: study protocol for a randomized controlled trial

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Abstract

Background

Glaucoma is a chronic eye disease associated with irreversible visual loss. In Africa, glaucoma patients often present late, with very advanced disease. One-off procedures, such as laser or surgery, are recommended in Africa because of lack of or poor adherence to medical treatment. However, acceptance of surgery is usually extremely low. To prevent blindness, adherence to treatment needs to improve, using acceptable, replicable and cost-effective interventions. After reviewing the literature and interviewing patients in Bauchi (Nigeria) motivational interviewing (MI) was selected as the intervention for this trial, with adaptation for glaucoma (MIG). MI is designed to strengthen personal motivation for, and commitment to a specific goal by eliciting and exploring a person's reasons for change within an atmosphere of acceptance and compassion. The aim of this study is to assess whether MIG increases the uptake of laser or surgery amongst glaucoma patients where this is the recommended treatment. The hypothesis is that MIG increases the uptake of treatment. This will be the first trial of MI in Africa.

Methods

This is a hospital based, single centre, randomized controlled trial of MIG plus an information sheet on glaucoma and its treatment (the latter being “standard care”) compared with standard care alone for glaucoma patients where the treatment recommended is surgery or laser.

Those eligible for the trial are adults aged 17 years and above who live within 200 km of Bauchi with advanced glaucoma where the examining ophthalmologist recommends surgery or laser. After obtaining written informed consent, participants will be randomly allocated to MIG plus standard care, or standard care alone. Motivational interviewing will be delivered in Hausa or English by one of two MIG trained personnel. One hundred and fifty participants will be recruited to each arm. The primary outcome is the proportion of participants undergoing laser or surgery within two months of the date given to re attend for the procedure. MIG quality will be assessed using the validated MI treatment integrity scale.

Discussion

Motivational interviewing may be an important tool to increase the acceptance of treatment for glaucoma. The approach is potentially scalable and may be useful for other chronic conditions in Africa.

Trial registration

ISRCTN79330571 (Controlled-Trials.com).

Keywords

Glaucoma, Motivational interviewing, Africa, Blindness, Treatment adherence, Randomized clinical trial

Background

Glaucoma, a chronic eye disease of unknown cause, is responsible for irreversible blindness in roughly 8.4 million people worldwide [1]. In Nigeria, the prevalence of blindness in those aged ≥ 40 years is 4.2% with 16.3% being due to glaucoma [2]. Glaucoma causes painless, progressive loss of the peripheral field of vision leading to total, irreversible blindness [3]. Primary open angle glaucoma (POAG), which is the most common type in Africa [4], is asymptomatic in the early stages [5]. In Africa, patients with glaucoma present very late, usually with a very advanced stage of the disease [6-11]. In an earlier unpublished study (Abdull MM, Stage at presentation of primary open angle glaucoma in Northern Nigeria) in the same clinic in Bauchi, 75% of the eyes of new glaucoma patients were already blind.

The aim of treatment in glaucoma is to lower the intraocular pressure (IOP), which slows or halts progression [12]. Treatments are daily eye drops, surgery or laser. Surgery and laser are one-off procedures, and laser can be repeated. Both have acceptably high rates of success. Eye drops (used daily for life) are not recommended in Africa except for educated people who live near eye units, as adherence in other groups is very low. Surgery is the

recommended treatment for glaucoma in Africa [13-16]. However, acceptance of surgery can also be extremely poor. In the earlier unpublished study carried out two years before the trial was planned, fewer than 5% of people offered surgery (trabeculectomy) returned for the procedure. Laser treatment was not available at that time. To prevent glaucoma blindness it is therefore necessary to improve acceptance and adherence to treatment using approaches that are acceptable, replicable and cost-effective in the African setting.

Motivational interviewing

A review of the literature on approaches to improve adherence to treatment of any kind, and findings from qualitative research in Bauchi were used to modify a form of counseling, called motivational interviewing (MI) [17]. Motivational interviewing is designed to strengthen personal motivation for and commitment to a specific goal by eliciting and exploring the person's own reasons for change within an atmosphere of acceptance and compassion. It has shown promise in psychiatry, substance abuse, and healthy life style changes and is being increasingly used in other fields of medical and health care [18-20]. It is an approach that can be taught at most levels [21,22], although it is complex to learn and training workshops alone are insufficient. We have named this modified form of MI as MI modified for glaucoma (MIG) for the purpose of this study.

A Cochrane review of interventions for improving adherence to eye drops for glaucoma did not find evidence to support any particular method [23]. None of the studies included in the review were undertaken in Africa and there is no review of acceptance of surgery or laser treatment. Other Cochrane reviews show the effectiveness of MI for other conditions [24,25].

To our knowledge this will be the first trial of this nature to be undertaken in Africa. Similar studies in the United Kingdom and United States have only assessed adherence to medical treatment [26,27].

There is a need for a strategy that is both feasible and effective in increasing awareness about the disease and its management, and the benefits of treatment, to improve acceptance. MIG is a relatively inexpensive technology and local people can be trained to deliver it in the local language. The pilot study described below demonstrated that MIG is acceptable to patients who are not literate and who have no or little knowledge of glaucoma. We acknowledge that there are difficulties in learning and applying this complex approach in the resource-constrained situation in Nigeria, where exposure to counselling of any type is unusual, and where a high proportion of the population have not received any formal education. Bearing this in mind, the two interviewers who will deliver the intervention come from the same community as study participants and are familiar with local social constructs, customs, beliefs and communication patterns, and are also bilingual in English and the predominant local language, Hausa.

The quality of counselling is important in all studies of this type. The Working Alliance Inventory questionnaire (WAI) [28] has been developed to assess the perceptions of both the counsellor and the participant. In this trial, WAI questionnaires will be completed immediately after the MIG session and analyzed as in other studies [29,30]. Recorded interviews will also be assessed for fidelity by independent experts, using the motivational interviewing treatment integrity (MITI) scale, a validated tool used for the fidelity testing of MI [31].

Pilot study October 2012 to March 2103

The purpose of the pilot study was to assess the acceptability and quality of MIG in adults with advanced glaucoma, to refine the study protocol and finalize data forms, to provide data for the sample size calculation, to refine recruitment and randomization processes and to estimate recruitment rates. The primary outcome was acceptance of laser or surgery on the date given, which was around one month after the date of diagnosis, recruitment and randomization.

Findings of the pilot study

All those eligible to be included in the pilot study agreed to take part, approximately 20 eligible patients were recruited each month, and the method of randomization using random numbers in sealed envelopes gave equal numbers allocated to MIG or no MIG. All who were offered a MIG interview accepted, and interviews took 20 to 30 minutes per session. None of those offered a second session returned and some participants preferred to have a relative or companion with them. None found the process distressing and reviewing the transcripts showed the quality of the MIG sessions to be satisfactory, but with room for improvement. Data on the primary outcome were available on 45 participants (Table 1). Nine of the nineteen (47%) participants who had undergone MIG underwent treatment compared with nine of the twenty six participants (35%) who had not undergone MIG. MIG therefore increased treatment rates by 12%. Overall acceptance was 40%, and 75% of these participants underwent laser treatment over surgery. No participants attended for surgery after the date given.

Table 1 Pilot study

		Had surgery			
		Yes	No		
MIG	Yes	9	10	19	47.4%
	No	9	17	26	34.6%
		18	27	45	

MIG, motivational interviewing modified for glaucoma.

We concluded that MIG is acceptable and the time interval for the primary outcome can be reduced from acceptance within four months of the date given for surgery or laser treatment, to acceptance within two months, as all those accepting treatment did so on the date given and none returned at a later date. Laser treatment is deemed to be more acceptable than surgery.

Methods/Design

The primary hypothesis is that MI, locally adapted for glaucoma and its treatment (MIG), increases the uptake of treatment amongst individuals with advanced glaucoma in Bauchi State, Nigeria.

A randomized controlled trial with 1:1 allocation to intervention or no intervention will be used to test this hypothesis.

Study setting

This is a single centre trial, taking place at Abubakar Tafawa Balewa University Teaching Hospital (ABUTH), Bauchi, Bauchi State, Nigeria. Dr M Abdull is the senior ophthalmologist. The eye department is new and has recently been re-equipped and additional staff appointed.

Participant eligibility

Inclusion criteria

Inclusion criteria for the trial are as follows: must be aged 17 years or above, have a confirmed diagnosis of POAG, have surgery or laser agreed to be the best option for further treatment, are able to understand Hausa or English, and must live within 200 km of the clinic.

Exclusion criteria

Exclusion criteria for the study are as follows: patient does not consent; there are other ocular morbidities, any diagnosed systemic diseases that contraindicate surgery or laser, communication problems (such as profound deafness), previous eye surgery (except cataract surgery), or have been referred to Abubakar Tafawa Balewa University Teaching Hospital (ATBUTH) specifically for glaucoma surgery.

Identification of potential participants and recruitment

Potential participants will be those with POAG where the examining ophthalmologist recommends surgical treatment (trabeculectomy with or without anti-scarring agents) or laser (diode laser trans-scleral cycloablation treatment of the ciliary body which is being increasingly used for advanced glaucoma) [32,33]. Patients with POAG will be identified by screening everyone aged 17 years and above who attends the outpatient department, regardless of their presenting complaint (s) (Additional file 1) Standard clinical procedures will be used to detect people who the ophthalmic nurse or optometrists suspect as having glaucoma, who will then be examined by an ophthalmologist to confirm the diagnosis. Criteria for referral to the ophthalmologist are one or more of the following:

A cup disc ratio of 0.7 or more in one or both eyes. Optic discs will be assessed in all patients by direct ophthalmoscopy through undilated pupils in a dark room. If the disc is not visible, the Van Herrick's test will be carried out to exclude narrow angles. The pupils will be dilated and optic discs examined at the slit lamp using a +60D lens; Cup disc ratio difference of 0.2 or more between the two eyes. Examination as before. The cup disc ratio of the two eyes will be compared to detect differences of 0.2 or more; Positive family history of glaucoma regardless of the eye findings. In the Rotterdam study there was a 9.2 relative risk for individuals with a family history of glaucoma [34]. In the Tasmania study the odds ratio of having a positive family history of POAG was 4.1 [35]. A person has a 20% risk if a parent has the disease, increasing to 50% for a sibling; IOP greater than 26 mmHg in the absence of a view of the discs, even after dilated examination, measured by Goldman application tonometry using standard techniques; Relative apparent pupillary defect (RAPD) assessed in a darkened room using the swinging flash light test [36]; and high myopia or history of distance spectacle use because of the association with glaucoma [37].

Everyone suspected of having glaucoma will be referred to the ophthalmologist (usually Dr Abdull, but other ophthalmologists will also be trained to detect those who are eligible) for a detailed routine ophthalmic examination. The ophthalmologist will confirm the diagnosis of POAG and determine the treatment of choice based the clinical findings (severity) and socio-economic factors likely to influence adherence to medical treatment (such as education and distance from the hospital). Long-term eye drops will be recommended for those who live near the hospital, are educated and can afford topical medication. These individuals will not be eligible for recruitment. Surgery or laser treatment will be recommended for those with an advanced stage of the disease where this offers the best hope for preventing blindness. These individuals will be potential participants. The ophthalmologist will then explain the disease, the treatment options, and the purpose of treatment, as is standard of care. Participants will choose whether to have laser treatment or surgery. The ophthalmologist will then prescribe eye drops and explain how they are to be used whilst waiting for surgery or laser treatment. Everyone offered surgery or laser treatment will be given a date within one month to re-attend for the procedure. Their name and hospital registration number will be written in the surgical register. They will then be escorted to the project manager for recruitment. Participants wishing to change their date of treatment will be offered a new date, and the surgical register, data record form and spreadsheet will be updated.

The eligibility of each potential participant will be checked by the project manager. All those eligible will be recruited after obtaining written informed consent. If the patient does not consent, reasons will be sought and recorded. After obtaining consent a unique identifier number will be issued. All those recruited will be given a red ID card which contains their name, hospital number and study ID. They will be required to present this card at the registration desk at every visit.

Randomization

The randomization list was generated in Excel, using the *rand between* function by Jennifer Evans, away from the project site. Block randomization with a variable block size was used to ensure that the groups will be balanced over time, as the uptake of laser treatment or surgery may fluctuate over time.

The option of MIG or no MIG was printed on headed paper which was signed and stamped. Each was placed in sequentially-numbered opaque envelopes according to the randomization schedule. Each envelope was sealed and stamped. The same was done for randomization to interviewer A or B. These procedures were undertaken in London by persons not involved in the trial.

For each participant, the interviewer in Bauchi will take the next envelope in the sequence and open it to see whether the patient is allocated to MIG or not. They will write the sequence number on the participant's form and their unique ID number on the outside of the envelope. After returning the letter to the envelope, the envelope will be kept in a sealed, locked container. The same process will be followed for allocation to interviewer A or B.

All participants, whether randomized to MIG or not, will be given an educational graphic leaflet called 'Silent Thief' (Additional file 2) All participants will, therefore, receive some additional information about glaucoma and its management.

MIG Intervention

Two trained personnel will deliver MIG sessions (Figure 1). The interview will be conducted in a quiet room within the clinic, in the participant's preferred language (Hausa or English). Interviewers and participants will be asked to switch off their mobile phones. The participant may be accompanied by someone of their choice.

Figure 1 Randomization Flow chart. IOP, intraocular pressure; MIG, motivational interviewing modified for glaucoma.

The interviewers will introduce themselves and explain that the session will be confidential. The interviewer will then try to engage the participant by presenting an agenda for discussion, giving the participant the option to choose where to start. The topics covered will be: awareness of glaucoma and the consequences of no treatment; acceptance of treatment options, especially surgery; adherence to topical medication when prescribed; and need for follow up to monitor the pressure inside the eye.

Open-ended questions will be used, with active listening and reflections. The interviewer will seek to understand the participant's perspective in an empathic fashion. Participant autonomy will be honored as information on glaucoma and its treatment will only be given if requested, or after gaining permission if the participant seems ready for this. The interviewer will listen for change talk, such as participants showing desire for surgery with terms like 'I wish to'; or an ability to undergo surgery, with 'I can'; or a reason for change, such as 'I need vision to save my job'; or commitment, with terms like 'I intend to'; or even a statement showing that the participant is already taking steps to come for surgery, 'I have discussed the need for financial support with my family'. The interviewer responds appropriately with reflections, affirmations, and requests for further elaboration or further evocation. At the end of the session, a summary of the interview will be presented to the participant by the interviewer.

The MIG sessions will seek to follow the spirit of MI, and will be recorded for later fidelity testing. Each interview session will last 30 to 60 minutes. All interview records will be kept in a locked cabinet in the office. After the interview, the WAI Short Questionnaire will be administered to establish if there was rapport and to assess the interviewer and patient's thoughts about the interview.

Under some circumstances a second MIG session might be required if the participant could not stay for the session on the day of recruitment, if the interview was not completed as the participant had to leave, or if there were frequent interruptions from the companion or others. If, in the opinion of the interviewer, the session could not be conducted as planned, the reasons will be recorded and the participant offered a second session.

Assessing the quality of the MIG intervention

This will be undertaken in three ways. Firstly, the WAI Short Questionnaire, which is completed by the interviewer and participant immediately after the session, will be used to investigate the relationship between the perceived quality of the interview and trial outcomes (Additional files 3 and 4) Participants who cannot see well, or who cannot read the questionnaire themselves will have the questions read out to them by the other interviewer (to reduce bias). Secondly, a random sample of interviews in English, and translated interview transcripts in Hausa will be sent for independent fidelity testing using the MITI scale, a

validated tool used for fidelity testing of MI. Thirdly, taped interviews in Hausa and English will be listened to by Dr Abdull and the interviewers on a regular basis throughout the trial as part of supervision sessions, to discuss how well the sessions are going, to identify issues which arise and learning needs, and how interviewing could be improved.

Outcomes

Primary outcome

The primary outcome will be the proportion of participants undergoing laser treatment or surgery within two months of the date given to attend the hospital for the procedure (Table 2. Participant timeline).

Table 2 Participants time line

Participant timeline:	T0	T1 Date for surgery/laser + 2 months	T2 T0 + 6 months	T3 T0 + 12 months
Diagnosis of glaucoma	X			
Standard explanation of disease/treatment	X			
Prescribed eye drops	X			
Recruitment	X			
Randomization	X			
MIG session	Yes/No			
Primary outcome assessment:				
Attended for surgery/laser		Yes/No		
Secondary outcome assessment:				
Visual acuity and IOP			X	X
Other measures:				
Adherence to topical medication			X	X
Reasons for not undergoing procedure			X	

Secondary outcomes

At 6 and 12 months after randomization the following will be assessed and recorded: mean IOP (can be measured by Tonopen in their home, if needed); proportion with loss of three or more lines of visual acuity, or loss of form vision (cannot read any letters on the chart) measured using a LogMar chart. This can be measured in their home, if needed; and mean number of follow-up visits to monitor IOP and other clinical parameters.

Other data

At 6 months from the date given for laser treatment or surgery, a subset of participants in each arm of the trial who do not undergo laser treatment or surgery will be contacted and asked to return to the clinic. Those who attend will be re-offered treatment; those who do not attend will be visited in their homes. The following data will be collected from all: scores using the Morisky questionnaire to assess adherence to topical medication, and reasons why participants did not undergo surgery or laser in both arms of the trial.

Sample size calculation

The sample size is based on the primary outcome and calculated using the SAMPSI command in Stata 12.1 statistical software (StataCorp Texas, USA). Based on the pilot study, we anticipate that 35% of participants in the standard care group will undergo surgery or laser

within two months of the date given for the procedure. A sample size of 150 in each arm will be required to detect an acceptance rate of 52.5% (50% relative and 17.5% absolute increase in acceptance) in people in the intervention arm (power 0.8, alpha 0.05). This is based on a calculation of 137 in each arm rounded up to 150 in each arm to allow for loss to follow-up. We believe this absolute increase of 17.5% (corresponding to a relative increase of 50% assuming a 35% acceptance in the control group) would be an important effect to detect. We have also calculated the power of a study of this size to detect differences between the treatment groups with respect to the secondary outcomes. IOP at entry to the study will average approximately 35 mmHg (SD +/- 14 mmHg) (values resulting from the pilot study). Our outcome is based on the final IOP at 12 months. This is likely to be in the order of 25 mmHg in the standard care group. The study will have good power (0.84) to detect differences of 5mmHG or more between the two groups at one year.

We have less information on the probability of losing three or more lines of visual acuity over the year. Figure 2 shows the proportion of participants losing three or more lines of visual acuity in the standard care group, with power curves for risk ratios of 0.5 and 0.8. It is more likely that we will be able to detect risk ratios in the order of 0.5. The power of the study to detect significant differences using a relative risk of 0.5 is shown in Table 3.

Figure 2 Proportion of participants losing three or more lines of visual acuity in the standard care group.

Table 3 Power of the study to detect significant differences using a relative risk of 0.5

% in standard care group losing 3 or more lines of visual acuity over 12 months	Power to detect RR of 0.5
10%	0.35
20%	0.58
30%	0.81
40%	0.94
50%	0.99
60%	1
70%	1
80%	1
90%	1

RR, Relative risk.

Blinding

Only participants allocated to MIG and the interviewers will know who has been allocated to MIG. The project manager and study ophthalmologist, who will be responsible for obtaining and checking data on the primary outcome, will be blinded to the intervention.

Ascertainment of outcomes

Primary outcome

All data on socioeconomic variables, clinical findings and the date given for surgery will be entered into a customized database on the day of recruitment. Software will be used to generate a spreadsheet which will be constantly updated. The spreadsheet will have the patient's unique ID, name, sex, hospital number, detailed address, contact phone number, the date given for surgery (or the revised date, if relevant), the date the patient came for surgery and the 'tracing date' (date two months after the date given for surgery). The spreadsheet will not contain the randomization sequence number to maintain blinding. The software will be

programmed to indicate the date two months after the date booked for laser treatment or surgery (or the revised date). This is the 'tracing date' when participants will be traced (see below). Every surgery day the spreadsheet will be reviewed to identify participants who should attend for surgery or laser treatment that day. The surgical register will be checked to see who did and who did not attend on the appointed operation day. The data recording form will be completed. The data will be entered into the database so that the spreadsheet can be updated.

Secondary outcomes

These outcomes will be assessed at 6 and 12 months after randomization. Participants may also attend at other time points for clinical reasons. At the 6 month (+/- one month) and 12 month visits (+/- one month), a full clinical examination will be performed on those who return. Data on IOP and visual acuity will be recorded. Participants who do not attend the 6 and/or 12 month visits will be traced, initially by telephone, requesting them to visit. If they still do not attend the clinic, they will be visited in their home, where their visual acuity will be measured using a LogMAR chart, and IOPs measured using a Tonopen.

Other measures

These will be assessed at 6 and 12 months after randomization. Adherence to topical medication in those not undergoing surgery or laser treatment will be assessed using the Morisky score [14] (Additional file 5). This can be administered over the phone, if necessary. Prior to assessing reasons for not undergoing surgery or laser treatment, the following will be assessed after taking verbal consent: a) whether they did in fact attend for surgery at ABUTH, but slipped through the net; b) they underwent surgery or laser treatment in another hospital, or were given more eye drops elsewhere; and c) they have not had any treatment for their glaucoma apart from the eye drops given at the time of recruitment.

Those who have not had any further treatment will be interviewed to find out why they did not attend. This can be administered over the phone. A subset of those not attending will be selected randomly, and visited in their homes for in-depth interviews where they will be asked why they did not return to the hospital. Responses will be probed to better understand the barriers that led to non-acceptance of laser or surgery. See Additional file 6 for the interview guide and probe questions.

Data collection

The following data will be collected using pre-tested data forms (Additional file 5).

Before and after recruitment at T0

Data will be collected for name, age, gender, clinical findings and date given to attend for surgery or laser treatment. For those who refuse, reasons for not agreeing to participate will be sought. For those who agree, contact details will be recorded: detailed address; telephone numbers of individual/family/neighbor; sociodemographic data and randomization sequence number. All data will be entered into a customized, password protected database on the day of recruitment. The form will be kept in a lockable cupboard only accessible to the project manager in an office dedicated to the trial, which is locked when not in use.

For those allocated to MIG the interview will be conducted at T0. If a second MI session is indicated, the reason for this will be recorded. After every interview, WAI questionnaires will be completed independently by the participant and the interviewer. These forms will be kept in a lockable cupboard in a separate office dedicated to the MIG interviews. This office will be locked at all times when not in use for MIG sessions. The project manager and ophthalmologist will not have access to these forms at any time. Data from these forms will be entered into a separate password protected database.

At time of ascertainment of primary outcome T1

Information on whether the participant underwent laser or surgery, which procedure was performed, and the date of the procedure will be recorded.

At time of ascertainment of secondary outcomes T2 and T3

The date attended and the IOP and visual acuity in the study eye will be recorded. The Morisky Adherence questionnaire will be administered. At T2 only, the reasons for not undergoing surgery or laser will be sought using closed-ended questions. Consent will be obtained to record all in-depth interviews. (See Additional file 6 for interview guide for in-depth interviews.)

Data management

Data entry

Databases have been created in Epidata and Access, with range and consistency checks. Data will be double entered by the project manager, who has been trained in data entry. Data will be entered as soon as possible after recruitment, so that the 'surgery date' and 'tracing date' outputs can be generated (as above). Random checks of the quality of data entry will be undertaken by Dr Abdull on a regular basis. Frequency distributions will be explored and data of outliers checked for accuracy.

Data analyses

The randomization code will only be broken once analysis of the primary outcome is completed. We will prepare a flow chart describing participant flow through the trial. This diagram will provide data on the following: the number of eligible people approached to take part in the trial, the number of people who agreed to take part, reasons for non-participation, the number of people randomly allocated to MIG and no MIG, the number of people who received the intervention as randomized, the number of people with data on the primary outcome by the intervention group, and the number of people followed up at 6 and 12 months by the intervention group.

We will compare people who agreed to take part in the trial with people who did not agree to take part in terms of age, sex, education and stage of glaucoma to assess the generalizability of the findings. All participants will be analyzed in the group to which they were randomized (by intention to treat).

We will compare the characteristics of the people in the two intervention groups with respect to age, sex, education, distance from hospital and stage of glaucoma at presentation to assess the balance between intervention groups.

We will describe the quality of the MIG in two ways. Firstly, by the WAI questionnaire scores for participants' and interviewers' perceptions of the MIG sessions. We will analyze this as a continuous variable but it is likely that the data will be skewed and we will therefore present medians, ranges and interquartile ranges, by interviewer. We will also compare this to other published data on WAI scores. Secondly, by fidelity testing using the MITI scale, which generates a series of scores that can be categorized as good or poor. We will present results by interviewer as done in published studies using the MITI.

Primary outcome

Our primary outcome is dichotomous (did or did not attend surgery or laser treatment within two months of their scheduled date). Our effect measure will be the risk ratio, that is, we will calculate the proportion of people with this outcome in the intervention group compared to the standard care group. We will report this with 95% confidence intervals. In a trial of 300 people we anticipate that the groups will be fairly well balanced. However, we will also calculate a risk ratio adjusted for factors that may affect uptake of surgery (stage of glaucoma, age, sex, education, and distance from hospital).

Secondary outcomes

We will analyze the dichotomous secondary outcomes in the same way. For the continuous secondary outcomes we will calculate the mean difference with 95% confidence intervals, if the data are reasonably normally distributed. Otherwise we will compare the two groups using the median value and assess the role of chance using non-parametric tests.

Subgroup analysis

We plan two subgroup analyses of the primary outcome. We will calculate the primary outcome risk ratio and do a test for interaction in the following subgroups: Interviewer A versus interviewer B, and 'Good' versus 'Poor' sessions according to the MITI scale (see above). We will tabulate reasons for not attending for surgery or laser treatment or follow-up by intervention group and the Morisky adherence scores by intervention group.

Consolidated Standard of Reporting Trials (CONSORT) guidelines will be used when reporting results.

Qualitative data

Interview recordings in Hausa will be transcribed and translated into English, if required. Transcripts will be coded using N vivo (QSR International, Victoria, Australia) and analyzed to identify reasons why individuals did not undergo the treatment recommended and to explore barriers.

Data monitoring

A Data Management Committee will be established, chaired by an independent clinical trialist. Membership to be confirmed. Stopping rules will not be required, as the intervention is acceptable and is unlikely to cause harm. The pilot study has also demonstrated that MIG is of a modest benefit. Interim analyses will not be undertaken. Meetings will be held regularly throughout the trial (every 6 months) to assess progress and advise if problems arise, and to assist in interpreting the results. Additional meetings will be called if required.

Ethics and dissemination

Ethical approval has been obtained from the Interventions Ethics Committee of the London School of Hygiene & Tropical Medicine, and from the Institutional Review Board of ATBUTH, Bauchi.

Protocol amendments

Important protocol amendments will be communicated to the Data Management Committee, the Interventions Ethics Committee of the London School of Hygiene and Tropical Medicine, the trial register, and will be reported in publications and reports.

Consent

Written informed consent will be obtained by the project manager. The information sheet and consent form will be available in Hausa and English. For those who cannot see well enough to read, or who cannot read, the information sheet will be read out and they will sign or provide a thumb print, which will be witnessed by the project manager. Additional consent will be obtained from those selected for in depth interviews. Specific consent will be obtained to record the interview, and for any anonymous quotes to be used.

Confidentiality

The names, ID and hospital number of those taking part in the trial will only be known to project staff. Study ID numbers will not be entered into the surgical register. As the surgery date and the date to start tracing individuals for primary outcome data requires names and hospital numbers, these will be need to be entered into the database.

Analysis of all the outcome data will be undertaken after removing all identifiers from the database and any quotes taken from the in depth interviews will use anonymous codes.

Access to data

The following individuals will have access to trial data: Clare Gilbert, Dr Abdull and Jennifer Evans.

Post-trial care

Standard clinical care will be provided to all study participants. No adverse events are anticipated.

Discussion

The trial is designed to assess the effectiveness of MIG in Nigeria in encouraging patients to accept surgery or laser treatment. The MI has been adapted because it is being undertaken in a language other than English and in a different culture where counselling is not the norm; it may be difficult to achieve the proficiency possible in a western audience. In the interview, questions, reflections and providing information are done in strict adherence to the spirit of MI. Interviews are conducted in the local language (Hausa), however participants who understand English may wish to be interviewed in English. At present, the fidelity assessment of motivational interviews using the MITI scale is conducted in English, but after discussion with the assessor it has been agreed that transcribed and translated interviews will also be used for assessment. However, transcripts lead to loss of vital information such as tone of voice, pauses and empathetic sounds. Assessing only interviews conducted in English may lead to bias, as participants who speak English are likely to be better educated and more aware of glaucoma and its treatment. The initial plan was to offer participants the option to come back for a second MIG session if they so desired, however, in the pilot study no-one returned for a second interview.

During the pilot study the duration of the interviews increased over time as the interviewers gained both experience and confidence. In the main trial participants will be told that the interview will last up to 60 minutes. The longer time will allow participants to ask more questions and so gain greater understanding of the decision they are being asked to make.

The criteria used for identifying glaucoma patients follow a guide by Foster *et al.* [38] and the values for cup: disc ratios and IOP come from the normative dataset of the Nigeria blindness and low vision survey (unpublished data (Kyari F, Normative data for glaucoma in Nigeria. Results from the National Blindness and Low Vision Survey Project). A limitation of our study is that visual field testing to aid detection of glaucoma is not feasible in a busy eye clinic. The criteria being used may miss some early glaucoma cases, but these individuals would not be eligible for the trial.

The sample size was calculated assuming that 35% of people in the control group will accept surgery. This estimate was obtained from a small pilot study and therefore may be unreliable. If the true acceptance in the control group is 30% then the study will be underpowered to detect a risk ratio of 1.5 (power = 0.69), however it will have good power to detect marginally larger risk ratios of 1.6 or more (corresponding to an absolute increase of 18% or more) (power = 0.84). If the true acceptance in the control group is higher, for example, at 40% then the study will have good power to detect a risk ratio of 1.5 (power = 0.90) (corresponding to an absolute increase of 20% or more). The planned sample size is feasible given the time and resources available for the study and the estimate of acceptance from the pilot study is the best that is available. With the present sample size, subgroup analyses may not be adequately powered to make conclusive inferences.

MI has the potential to be taken to scale in Nigeria and other limited-resource settings, as pre-existing skills in counselling are not required. Indeed, it has been suggested that counselling-naïve individuals are better at MI than those with previous experience, as the main qualities required are empathy, good listening skills and patience. MI also has the potential to be used for other eye conditions where uptake is known to be poor (such as cataract surgery, or lid surgery for trachoma cases) or for other non-ocular conditions.

Trial status

Recruitment started on 2 September 2013. By the end of January 2014, 70 participants had been recruited, and only one of those eligible has refused.

Abbreviations

ATBUTH, Abubakar Tafawa Balewa University Teaching Hospital; CONSORT, Consolidated Standard of Reporting Trials; IOP, Intraocular pressure; MI, Motivational interviewing; MIG, Motivational interview for glaucoma; MITI, Motivational interviewing treatment integrity scale; POAG, Primary open angle glaucoma; RAPD, Relative afferent pupillary defect; RR, Relative risk; VCDR, Vertical cup-disc ratio; WAI, Working alliance inventory.

Competing interests

The authors declare that they have no competing interests.

Authors' contributions

MA: Conception and design; data collection; manuscript writing and final approval of the manuscript. CG: Conception and design; revising draft for important intellectual content; final approval of the manuscript. JE: Design; revising draft for important intellectual content; final approval of the manuscript; JMcC: Design; revising draft for important intellectual content final approval of the manuscript; All authors read and approved the final manuscript.

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Additional files

Additional_file_1 as PDF

Additional file 1 Randomization flowchart: Flow chart of activities.

Additional_file_2 as DOCX

Additional file 2 Glaucoma the silent thief: Educational material.

Additional_file_3 as PDF

Additional file 3 Working alliance inventory for interviewer: Questionnaire.

Additional_file_4 as PDF

Additional file 4 Working alliance inventory for patient: Questionnaire.

Additional_file_5 as XLS

Additional file 5 Main data record form: Main form for data capture.

Additional_file_6 as DOCX

Additional file 6 Interview guide: Interview guide for those who fail to attend for surgery/laser.

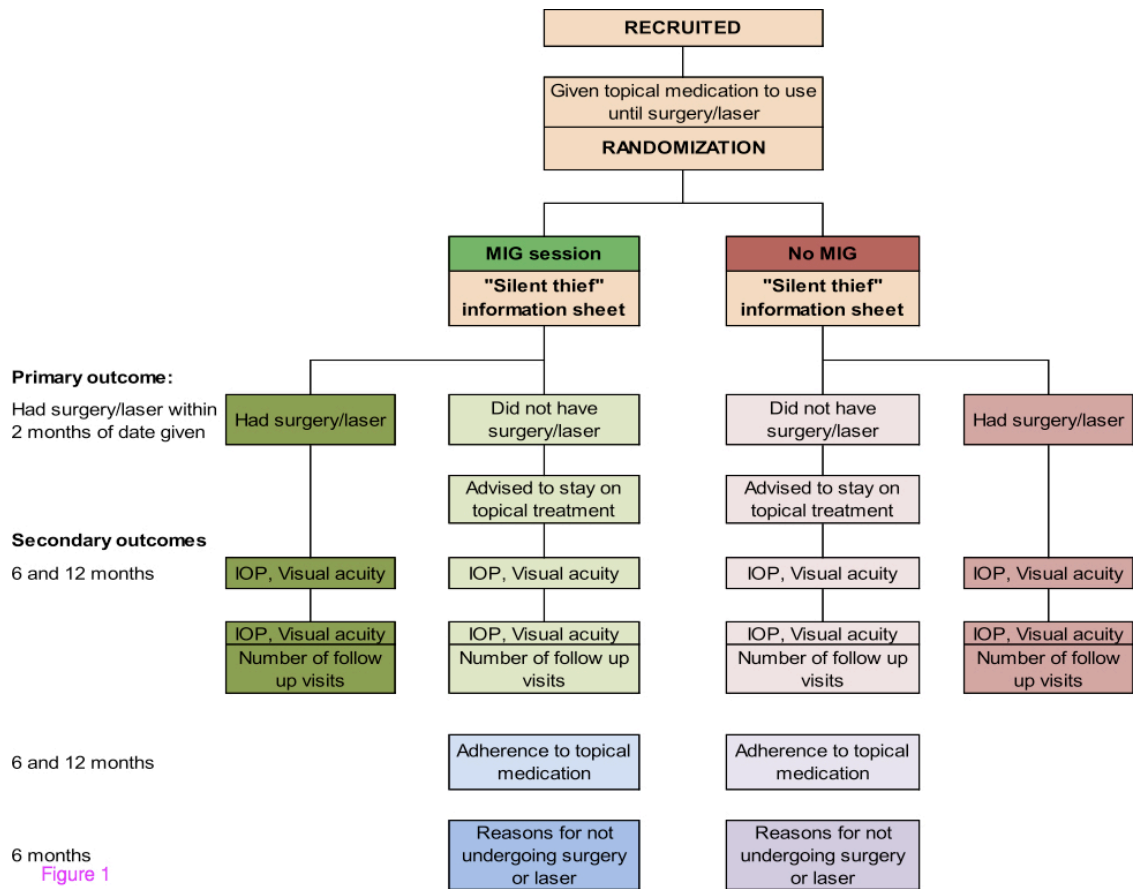
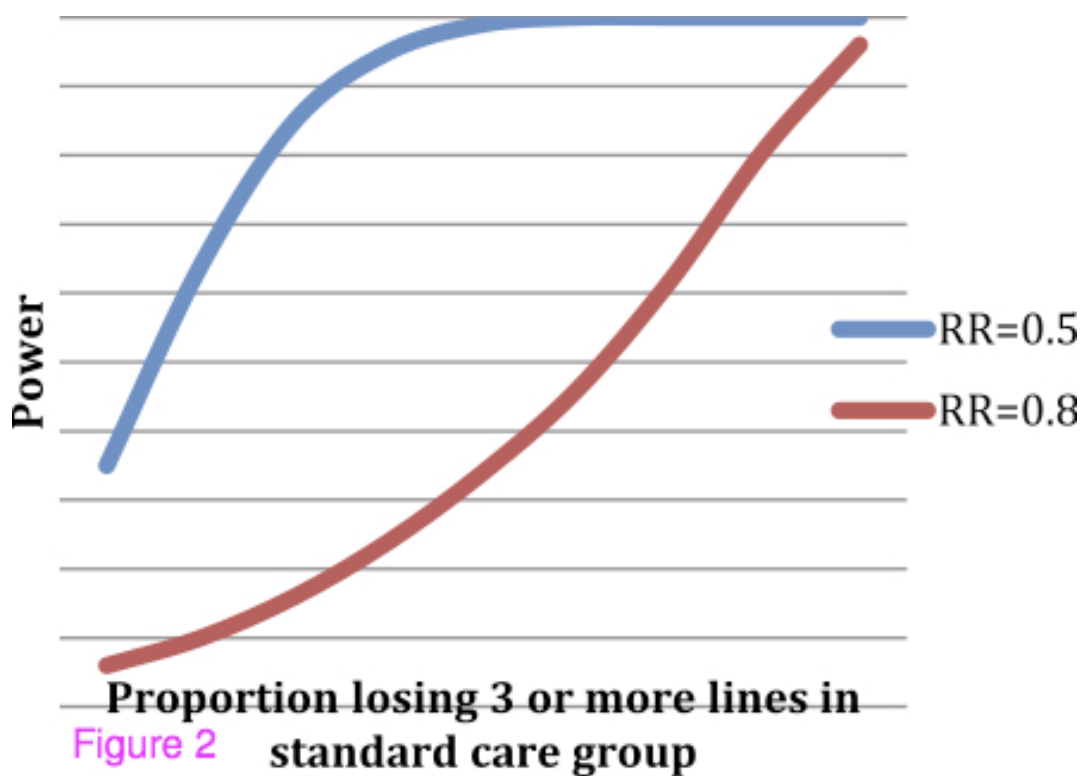


Table 1- Pilot study

		Had surgery			
		Yes	No		
MIG	Yes	9	10	19	47.4%
	No	9	17	26	34.6%
		18	27	45	



Additional files provided with this submission:

Additional file 1: 2169610711095482_add1.pdf, 50K
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Chapter 6: Interventions to improve glaucoma management

Results of the randomized clinical trial

The following paper describes the primary outcome of the randomised clinical trial of adapted MI to improve the uptake of surgery or laser in the study area. The paper has been accepted for publication in Journal of Glaucoma.

1. Can adapted motivational interviewing to improve the uptake of surgical or laser treatment for glaucoma in Nigeria: a randomized controlled trial. Abdull MM, McCambridge J, Evans J, Muazu F, Gilbert C. Journal of Glaucoma. In press



Figure 12: Home visit to measure a patient's IOP with a hand held Perkins tonometer in her home following tracing after failing her scheduled appointment

Paper 13: Can adapted motivational interviewing improve the uptake of surgical or laser treatment for glaucoma in Nigeria: randomized controlled trial

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RESEARCH PAPER COVER SHEET

PLEASE NOTE THAT A COVER SHEET MUST BE COMPLETED FOR EACH RESEARCH PAPER INCLUDED IN A THESIS.

SECTION A – Student Details

Student	MOHAMMED MAHDI ABDULL
Principal Supervisor	Clare Gilbert
Thesis Title	Adapted motivational interviewing to improve uptake of treatment in glaucoma patients in Bauchi state, Nigeria:

If the Research Paper has previously been published please complete Section B, if not please move to Section C

SECTION B – Paper already published

Where was the work published?	Journal of Glaucoma		
When was the work published?	July 2017		
If the work was published prior to registration for your research degree, give a brief rationale for its inclusion			
Have you retained the copyright for the work?*	Yes	Was the work subject to academic peer review?	YES

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Where is the work intended to be published?	
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For multi-authored work, give full details of your role in the research included in the paper and in the preparation of the paper. (Attach a further sheet if necessary)	Collected the data, Wrote the draft, Analysed the result with other authors, accepted comments and incorporated them in the final draft
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Student Signature: ASL

Date: 20/07/2017

Supervisor Signature: Clare Gilbert

Date: 20/7/2017

Can adapted motivational interviewing improve uptake of surgical or laser treatment for glaucoma in Nigeria: randomized controlled trial

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ABSTRACT

Purpose: To assess whether adapted motivational interviewing has any impact on the proportion of participants who subsequently underwent surgery or laser treatment for glaucoma.

Methods: A single site randomized controlled trial in Bauchi, Nigeria. Participants were new patients with a confirmed diagnosis of primary open angle glaucoma in one or both eyes, where surgery or laser was recommended. Intervention was a session of motivational interviewing adapted for glaucoma and the local context, using an interview guide based on local qualitative research. Participants were randomly allocated to intervention or usual care. Usual care was routine explanation by an ophthalmologist and an educational pamphlet. After the interview, a 12-item Working Alliance Inventory questionnaire was administered to patient-interviewer pairs to assess the collaborative relationship.

Results: 276 glaucoma patients participated; 70% males. 135 (49%) were assigned to adapted motivational interviewing and 141 to usual care. All received the intervention as allocated. Uptake (i.e., the proportion who underwent treatment) of laser or surgery in the motivational interviewing group was 52% compared with 45% in the usual care group (risk difference 7.2%, 95% confidence interval -4.5-18.9%). Mean Working Alliance Inventory scores were 68.0 for interviewers and 68.5 for participants with a combined reliability coefficient of 93.9% (i.e., high internal consistency and reliability).

Conclusion: We observed only a small increase in the uptake of surgery or laser with motivational interviewing compared with usual care which was not statistically significant. Although only 1 in 2 patients accepted surgery or laser in this trial, this is a much higher proportion than in other studies.

Key words: Glaucoma, Motivational interviewing, Treatment uptake, Africa

INTRODUCTION

Glaucoma is a public health problem in Africa, with the prevalence of blindness due to glaucoma higher than in other regions, with an aggressive course,^{1,2} higher rates among young people³, and late presentation⁴ on account of lack of primary eye care and awareness, reduced access to treatment and low awareness of the risk of having primary open angle glaucoma (POAG)⁵. Health facilities are also poorly equipped⁶ with inadequate human resources and limited treatment options. Exacerbating these problems is poor acceptance of and adherence to trabeculectomy, the preferred treatment in Africa,^{7,8} as patients experience no immediate visual benefit and are fearful of the procedure.⁹ For prevention of blindness in glaucoma there are modifiable factors such as increasing awareness by education,^{10,11} and encouraging change in acceptance and adherence to treatment and follow up.

In this study motivational interviewing (MI) was selected as the intervention to enhance uptake of treatment (i.e., they accept and actually undergo treatment). Motivational interviewing has been described as “a collaborative, goal-oriented style of communication with particular attention to the language of change. It is designed to strengthen personal motivation for and commitment to a specific goal by eliciting and exploring the person’s own reasons for change within an atmosphere of acceptance and compassion”.¹² Guidance includes giving information whilst honouring patient autonomy. Motivational interviewing was originally developed for addictive behaviours,¹³ and a wide range of applications have been developed.¹²

In this study MI was adapted as an approach to counselling for use in patients with glaucoma, and hereafter is referred to as adapted motivational interviewing for glaucoma (AMIG). The purpose of the trial was to assess whether AMIG has an impact on the uptake of surgery or laser treatment by glaucoma patients. The hypothesis tested was that AMIG increases the uptake of treatment (surgery or laser treatment) among glaucoma patients in comparison with enhanced usual care.

Setting

The trial was undertaken in the eye clinic of Abubakar Tafawa Balewa University Teaching Hospital (ATBUTH), Bauchi State, in the North East of Nigeria. More than 80% of the catchment population of approximately four million people live in rural areas or live on less than one United States Dollar (USD) per day, with low levels of literacy (males 53%, females 13%).¹⁴ All new patients attending the ATBUTH eye clinic are allocated a unique medical record number and are given a green registration card, which includes the dates of clinic attendance, registration and surgical appointments. Surgery

is performed twice a week, and if lists are cancelled in advance patients are notified and given another date to attend. It is extremely rare for patients to attend for surgery on any date other than the date given. All operations are recorded in the operating theatre register, giving details of their name, age, sex, hospital record number and surgical procedure. A register of all new glaucoma patients was initiated before the trial started.

METHODS

The definition of POAG used in the trial followed that recommended by Foster in 2002¹⁵ which has been applied to normative data from the Nigeria National Blindness and Low Vision Survey.¹⁶ The values which defined glaucoma were IOP greater than 26mmHg (the 97.5th percentile for IOP from the Nigeria Blindness Survey), and a vertical cup disc ratio (VCDR) of more than 0.7 (the 97.5th percentile for VCDR from the Nigeria Blindness Survey) with visual field loss consistent with glaucoma in one or both eyes.

Trial design

This was a single site effectiveness trial with 1:1 allocation to evaluated intervention or enhanced usual care.¹⁷ No changes were made to the protocol after the trial started. The trial is reported in accordance with the CONSORT statement.^{18,19} The full protocol has been published and can be assessed at

<http://trialsjournal.biomedcentral.com/articles/10.1186/1745-6215-15-149>. The trial is registered at Controlled-Trials.com, registration number ISRCTN79330571, available at the following URL.

<http://www.isrctn.com/ISRCTN79330571?q=abdull&filters=&sort=&offset=1&totalResults=1&page=1&pageSize=10&searchType=basic-search>.

Inclusion criteria: New patients (i.e., first attendance at ATBUTH) with a confirmed diagnosis of POAG in one or both eyes, where surgery or laser was recommended as the treatment of choice to preserve vision. The surgeon decided which eye was most in need of urgent treatment. Other inclusion criteria included aged 17 years or above, ability to understand Hausa or English and lived within 200 km of the clinic.

Exclusion criteria: Patients who had ocular comorbidities or systemic diseases that may contraindicate surgery or laser, communication problems such as profound deafness, previous ocular surgery (except cataract surgery), specific referral for glaucoma surgery, or lack of consent to participate.

Intervention

The intervention was a single session of MI adapted for the local context and language using a draft interview guide generated following a qualitative study.⁹ The principal researcher was trained in MI in Europe in two workshops and subsequently coached the two study interviewers. They worked together in pilot interviews until a satisfactory level of competence had been reached. The interviewers conducted all the interviews in a quiet room in the clinic, in the participant's preferred language (Hausa or English). The interviewer engaged the participant by presenting an agenda for discussion which included awareness of glaucoma and the consequences of no treatment, acceptance of surgical treatment options, adherence to prescribed medication and follow up to monitor the eye pressure. Open-ended questions were asked, with active listening including reflections. The interviewers sought to understand the participant's perspective in an empathic fashion and listened for evidence of change talk.

Fidelity to MI (whether delivery adheres closely to the approach) can be assessed using the Motivational Interviewing Treatment Integrity code (MITI).²⁰ The extent to which a collaborative relationship forms between interviewer and client is assessed using the Working Alliance Inventory (WAI)²¹ and high WAI scores given by interviewers and clients indicate greater connection between the two parties. The AMIG sessions sought to follow the spirit of MI, and were recorded. Interview sessions lasted 35 to 60 minutes. After the AMIG interview, the 12-item WAI Short Questionnaire (WAI-SR) was administered to each participant and interviewer to assess the collaborative relationship.²¹

Outcomes

The primary outcome was the proportion of participants who accepted and underwent surgery or laser treatment (i.e., uptake) within two months of the date given for the procedure.

Sample Size

The sample size was calculated based on the primary outcome using the SAMPSI command in Stata 14 statistical software (Stata/IC14.0; Stata Corp, College Station, TX, USA). Based on the pilot study, we anticipated that 35% of people in the control group would accept and undergo surgery or laser treatment within two months. A sample size of 137 in each arm was required to detect a 50% relative or 17.5% absolute increase in

uptake (equivalent to an uptake of 52.5% in the intervention group) (power 0.8, alpha 0.05). The sample size of 137 was rounded up to 150 in each arm to allow for loss to follow-up. No subgroup or interim analyses were planned.

Recruitment

Eligible patients were identified for enrolment by the ophthalmologists who referred them to the Project Manager for recruitment. The Project Manager ensured that potential participants understood the information sheet and signed the consent form. They were given a unique study ID and demographic information, home address and telephone number collected to enable subsequent tracing.

All participants were given a red card with their name, hospital medical record number and their trial ID. They were instructed to present this card to the Project Manager at every attendance at the clinic, and on presentation they were fast tracked through the system. Clinical examination, treatment recommendation, randomization, data collection and entry into the trial database were all undertaken on the same day.

Randomisation

Sequence generation: A statistician, not at the project site, generated the randomization list using the *randbetween* function in Excel (Office 2013, Microsoft inc). Block randomization with variable block sizes was used to ensure balance in the groups over time, as the uptake of laser or surgery may fluctuate over time.

Allocation concealment mechanism: The option of AMIG or no AMIG was printed on headed paper, signed and stamped off-site, in London by persons not involved in the trial. These were placed in sequentially numbered opaque envelopes in accordance with the randomization schedule, which were then sealed and stamped. A second similar procedure was followed to randomize those allocated to AMIG to either interviewer A or interviewer B. These envelopes were kept in a locked cupboard and were only opened when needed.

Implementation: Immediately after recruitment the next envelope in the sequence was opened to see if the patient was allocated to AMIG or not. The interviewers wrote the sequence number on the participant's form and their unique ID number was written on the outside of the envelope and returned to a sealed locked container. The same processes were adopted for allocation to interviewer A or B.

Procedures

During the clinical consultation with the attending ophthalmologist before randomization, an explanation of glaucoma was given to all participants as well as the treatment options and prognosis.²² After explaining treatment options the ophthalmologist recommended one form of treatment, taking account of the severity of disease and socio-demographic variables. Usual care was enhanced by providing all participants in both groups with written information, in Hausa or English, about glaucoma. This written information was developed and pilot tested following interviews with glaucoma patients. The pamphlet, which was called the “Silent Thief”, contained images to represent visual field loss and conveyed simple messages. A copy of the pamphlet was also displayed at the entrance to the clinic.

The date for surgery or laser was determined at the first consultation and name, age, sex, hospital medical record and procedure were entered into the operating list. Patients were informed of the date orally and it was written on their red card. The date and type of surgery were recorded in the database. A separate tracing database was created containing the agreed date of surgery for each participant and a date two months after this date was generated automatically.

Severity of glaucoma in the study eye was categorized as early, moderate, advanced or end stage, based on VCDR and visual field loss. The former was assessed subjectively by the ophthalmologist using direct or indirect ophthalmoscopy or with fundus photography with a DRS digital fundus camera (CentreVue SpA Padova, Italy). Visual fields were assessed using an Oculus Twinfield Visual field analyser (OCULUS Optikgeräte GmbH). Early glaucoma was defined as VCDR of less than 0.8 with very little to no visual field loss, moderate as a VCDR less than 0.8 with a visual field greater than 10 degrees, advanced as a VCDR of 0.8-0.9 with a visual field of approximately 5-10 degrees and end stage was defined as a VCDR of 1.0, with a visual field of 5 degrees or less, including when no visual field could be recorded.

Ascertainment of the primary outcome

Every operating day the operating list was checked by the Project Manager to ascertain whether trial participants had attended for laser or surgery on the day allocated, by cross checking details in the operating book with those in the trial database. For those attending, the date and type of treatment performed were recorded. Participants who did not attend on the date allocated but who attended within the two month period were identified by presentation of their red cards to the Project Manager.

Masking

Only participants allocated to AMIG and the AMIG interviewers knew who had been allocated to AMIG. Participants were asked by the interviewers not to discuss whether they had had an interview with the Project Manager, ophthalmologists or other patients to avoid contamination and to maintain masking. In particular, the Project Manager, who was responsible for assessing the primary outcome, was masked to the treatment allocation.

Data management

Two databases were created in Epidata (EpiData Odense Denmark, EpiData Association, 2010-. [Http://www.epidata.dk](http://www.epidata.dk)) with range and consistency checks. The Project Manager entered data into the main trial database. Data were entered as soon as possible after recruitment, so that the 'surgery date' and 'tracing date' outputs could be generated. All data entries were double-checked by the lead researcher (MA). The second database, which was maintained by the interviewers, contained the unique ID, allocation status for AMIG and interviewer, and WAI data. The databases were maintained on separate password protected computers in different lockable offices. Random checks of the quality of data entry were regularly performed in Stata (Stata/IC14.0; Stata Corp, College Station, TX, USA).

Data analyses

The randomization code was broken only after analysis of the primary outcome, which was by intention to treat. There were no missing data on the primary outcome. We compared the proportion of people in the intervention and control group achieving the primary outcome (uptake of surgery or laser treatment) using the risk ratio and the risk difference and report these two measures of effect with 95% confidence intervals (calculated using the 'epitab' command in Stata 14). Univariate and multivariable logistic regression analyses were performed to explore factors associated with undergoing surgery or laser treatment such as gender, age group, distance to hospital, education, occupation, mode of presentation, severity of disease, baseline IOP and interviewer. Analysis by interviewer was performed to explore whether the primary outcome varied with the interviewer performing AMIG. Post-hoc analysis of the primary outcome and WAI data was undertaken to compare outcomes and quality of the earlier and later AMIG interviews (first half versus second half).

Working Alliance Inventory questionnaires for participants' and interviewers' ratings of the AMIG sessions were analyzed as total WAI scores and medians. Cronbach's alpha test was applied to participant and interviewer total scores to assess the level of correlation between scores. Data were also analysed to assess whether WAI scores for participants, and for interviewers, were associated with the primary outcome using median split WAI scores using Pearson chi square test.

RESULTS

Recruitment was slower than anticipated due to civil unrest in North Eastern Nigeria (September 2013 to September 2015). Only one eligible patient refused to participate (Figure 1). A total of 276 glaucoma patients participated in the study. 135 (49%) were assigned to the intervention group and 141 to the control group. All received the intervention as allocated. There were no major imbalances between the two groups at baseline (Table 1).

Table 1. Baseline socio-demographic and ocular variables, by allocation arm

		AMIG* n=135 % (n)	No AMIG n=141 % (n)	Total n=276 % (n)
Gender	Male	71% (96)	68% (96)	70% (192)
	Female	29% (39)	32% (45)	30% (84)
Age group	16-30 years	12% (16)	9% (12)	10% (28)
	31-50 years	39% (53)	34% (48)	37% (101)
	51-70 years	44% (59)	46% (65)	45% (124)
	>71 years	5% (7)	11% (16)	8% (23)
Education	None	17% (23)	18% (26)	18% (49)
	Primary/secondary school	36% (48)	26% (37)	31% (85)
	Graduate/post graduate	27% (36)	33% (47)	30% (83)
	Informal schooling	20% (27)	22% (31)	21% (58)
	Missing	1% (1)	0% (0)	0%
Distance to clinic	≤10 km	65% (88)	52% (73)	58% (161)
	>10-100km	13% (18)	24% (34)	19% (52)
	>100	17% (23)	22% (31)	20% (54)
	Missing	4% (6)	2% (3)	3% (9)
Ocular variables POAG severity	None/early	7% (10)	12% (17)	10% (27)
	Moderate	16% (21)	16% (23)	16% (44)
	Advanced	47% (63)	37% (52)	42% (115)
	End stage	29% (39)	33% (47)	31% (86)
	Missing	2% (3)	1% (2)	2% (5)
Presenting visual acuity	≥20/60	32% (43)	24% (34)	28% (77)
	<20/60-20/400	30% (41)	38% (53)	34% (94)
	<20/400	37% (50)	38% (53)	37% (103)
	Missing	1% (2)	1% (1)	1% (3)
Presenting IOP	Normal <21 mmHg*	13% (17)	10% (14)	11% (31)
	High 21-40 mmHg	52% (70)	60% (85)	56% (155)
	Very high >41 mmHg	33% (45)	28% (40)	31% (85)
	Missing	2% (3)	1% (2)	2% (5)
Treatment recommended at recruitment	Laser cyclophotoablation	93% (131)	84% (114)	89% (245)
	Trabeculectomy	5% (7)	10% (13)	7% (20)
	Trabec. + cataract surgery	1% (1)	3% (4)	2% (5)
	Laser trabeculoplasty	0% (0)	1% (2)	1% (2)
	Laser + cataract surgery	0% (0)	1% (1)	0% (1)
	Missing	1% (1)	1% (1)	1% (3)
TOTAL		100% (135)	100% (141)	100% (276)

*AMIG- Adapted motivational interview for glaucoma

In almost all patients (89% of the 276 participants) laser treatment was recommended, in 7% glaucoma surgery alone was recommended and in 4% a combination of cataract surgery with trabeculectomy or laser was recommended. Slightly more of the intervention group (93%) were recommended laser compared with the control group (84%) but this difference was not statistically significant. When participants attended for treatment they were administered the treatment they preferred. All 133 treated patients underwent laser treatment by choice which was the treatment recommended in all but 13.

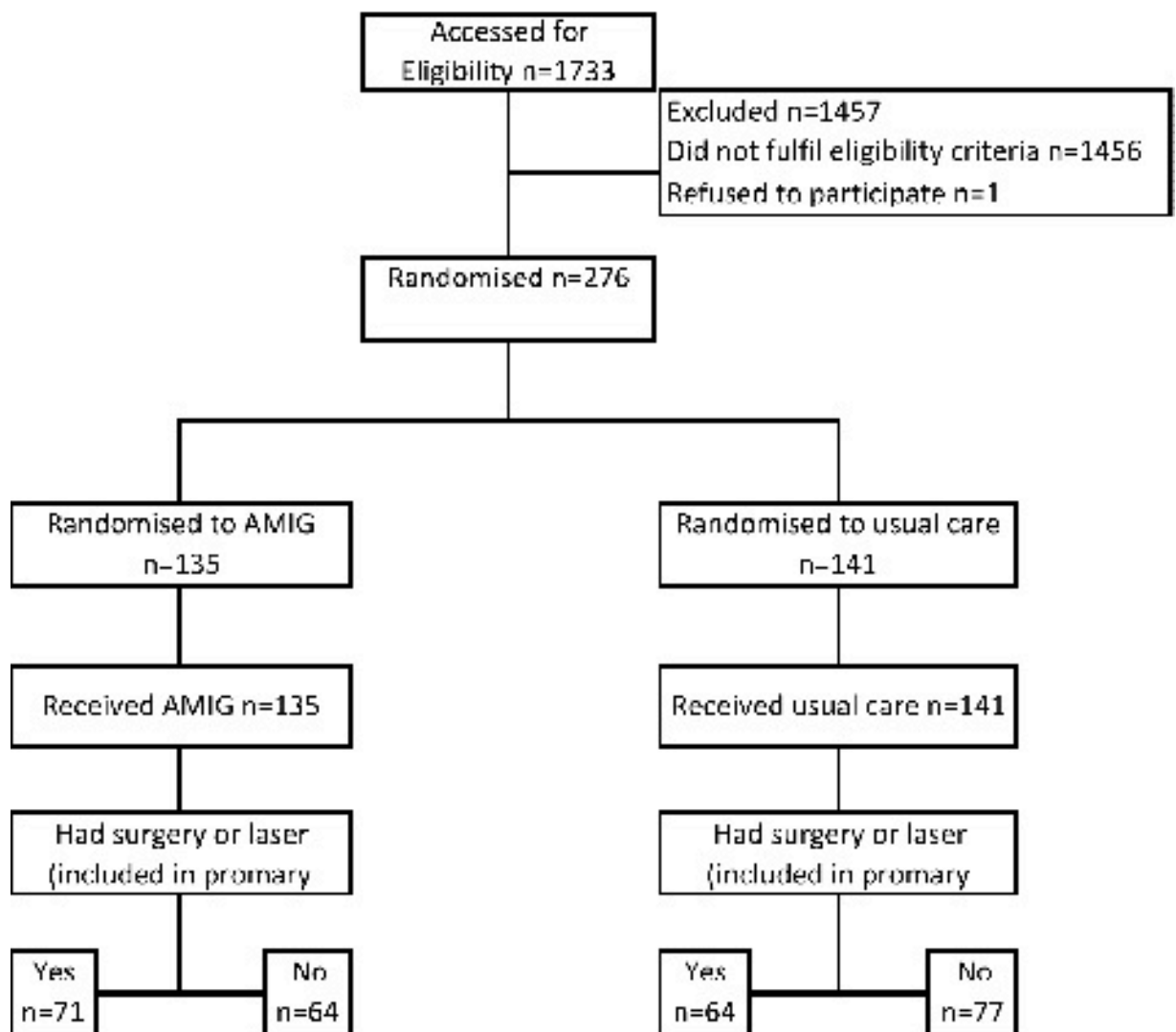


Figure 1: Participant flow diagram showing enrolment of participants

Outcomes

Primary outcome

Uptake of treatment in the AMIG group was 52% compared with 45% in the usual care group (Table 2). The risk ratio was 1.2 (95% confidence interval (CI) 0.9-1.5) and the risk difference was 7.2% (95% CI 0-18.9%).

Table 2: Results of primary outcome of the trial, uptake of surgery or laser

Acceptance	AMIG*	No AMIG	Total
	% (n)	% (n)	% (n)
Underwent laser or surgery	52% (70)	45% (63)	48% (133)
Did not undergo laser or surgery	48% (65)	55% (78)	52% (143)
Total	100% (135)	100% (141)	100% (276)

*AMIG – Adapted motivational interviewing for glaucoma

The number of participants allocated to interviewer A was 68 and 67 to interviewer B. There was no significant difference in the uptake of treatment between interviewer A and interviewer B, being 46% for interviewer A and 54% for interviewer B (Pearson $\chi^2(1)$: 0.9073; $p = 0.34$).

In the first 138 patients recruited (of the 276 total) the risk ratio was 1.1 (95% CI 0.8-1.5) and the risk difference was 2.8% (95% CI -13.8-19.5%). In the last 138 recruited the risk ratio was 1.3 (95% CI 0.9-1.8) and the risk difference was 11.3% (95% CI -5.2-27.9%). There were no differences in interviewer and participant median WAI scores during the two time periods (69% and 71% vs 69% and 71% respectively).

In univariate analysis, participants with either graduate/post graduate or informal education were more likely to undergo treatment than and those with no education (Pearson χ^2 , 15.16, $p = 0.01$). There were no other statistically significant predictors of uptake of treatment by socio-demographic or ocular variables in the univariate analyses. Education was also strongly predictive in the multivariable analysis (Table 3).

Table 3: Multivariable logistic regression analysis of factors affecting uptake of surgery or laser

	Uptake	n	Odds Ratio	95% Confidence Interval	P value
Intervention	No AMIG	141	Ref		
	AMIG	135	1.60	0.91 - 2.81	0.10
Socio-demographic variables					
Gender	Male	192	Ref		
	Female	84	1.92	0.83 - 4.47	0.13
Age group	16-30 years	28	Ref		
	31-50 years	101	4.20	1.22 - 14.44	0.02
	51-70 years	124	3.09	0.90 - 10.64	0.07
	>71 years	23	3.65	0.75 -17.63	0.11
Occupation	Unemployed/housewife	39	Ref		
	Professional	36	0.15	0.04 - 0.60	0.01
	Worker/labourer	50	0.55	0.16 - 1.95	0.36
	Trader	29	1.59	0.45 - 5.62	0.47
	Retired	83	0.50	0.16 - 1.52	0.22
	Student	16	0.27	0.05 - 1.57	0.15
	Other	23	0.52	0.13 - 2.17	0.37
Distance from home to hospital	<10km	161	Ref		
	>10-100km	52	1.57	0.72 - 0.43	0.26
	>100	54	0.76	0.35 - 1.62	0.47
	Missing	9			
Education	No formal education	49	Ref	Missing data	
	Informal schooling	85	5.70	2.15 - 15.10	<0.001
	Primary/secondary school	83	4.62	1.60 - 13.32	0.01
	Grad/post grad	58	9.44	2.97 - 30.04	0.00
	Missing	1			
Ocular variables					
Visual acuity	>20/60	77	Ref		
	<20/60-20/400	94	0.59	0.26 - 1.31	0.19
	<20/400	103	0.51	0.18 - 1.44	0.20
	Missing	2			
POAG severity	Early	27	Ref		
	Moderate	44	0.81	0.28 - 2.32	0.69
	Advanced	115	1.52	0.55 - 4.25	0.42
	End stage	86	2.42	0.66 - 8.92	0.18
	Missing	4			
IOP group	Normal	31	Ref		
	High 21-40 mmHg	155	3.29	1.20 - 8.98	0.02
	Very high >41 mmHg	85	2.94	0.97 - 8.91	0.06
	Missing	5			

AMIG= Adapted motivational interviewing for glaucoma

In the adjusted analysis (Table 3) the odds ratio for undergoing treatment was 1.6 (95% CI 0.9-2.8) but this was not statistically significant.

Fidelity testing using MITI for English language sessions was planned, but was not possible because all interviews were conducted in local languages, Hausa or Pidgin English, which prevented formal coding.

Analysis of Working Alliance Inventory scores

Analysis of WAI showed similar scores for participants and interviewers overall and were similar for both interviewers (Table 4).

Table 4: Correlation between participant and interviewer Working Alliance Inventory scores

	Mean WAI score
WAI interviewers (n=132)	68.0 (range 45-74; SD 5.06)
WAI patients (n=135)	68.5 (range 42-78; SD 5.16)
WAI interviewer A (n=66)	67.3 (range 45-73; SD 5.53)
WAI interviewer B (n=66)	68.6 (range 52-74 SD 4.49)
Cronbach's alpha patient and interviewer total scores	
Test scale = mean (unstandardized items)	
Average inter-item covariance	23.13
Number of items in the scale	2
Scale reliability coefficient	93.9%
Cronbach's alpha interviewer	
Test scale = mean (unstandardized items)	
Average inter-item covariance	0.25
Number of items in the scale	12
Scale reliability coefficient	94.3%
Cronbach's alpha patient	
Test scale = mean(unstandardized items)	
Average inter-item covariance	0.21
Number of items in the scale	12
Scale reliability coefficient	93.3%

WAI = Working Alliance Inventory. SD = standard deviation

Analysis of WAI scores gave the same median split for participant and interviewer scores overall (median scores 70 for both). There were no statistically significant differences in the primary outcome by interviewer median split WAI scores.

There were no harmful or unintended effects in either group.

DISCUSSION

Participants in the AMIG arm underwent treatment at a higher rate than the usual care group (a difference of approximately 7%) but this difference could have arisen by chance. This is the first trial to use this counselling intervention for glaucoma in Africa, and the results do not support introduction of adapted MI into routine practice.

The sample size calculation was based on a pilot study of 45 individuals in which there was an absolute difference of 12% between AMIG (47% uptake) and usual care (35% uptake) groups, but a difference of this magnitude may have occurred by chance as the sample size was small.¹⁷ In the main trial the observed risk difference does not exclude the possibility of a 19% difference. There was no difference in uptake of treatment by interviewer, which reflects the similarities in WAI scores.

In this trial all participants underwent laser treatment, which was described as “computer light treatment”, probably because this term induces less fear than the term surgery.⁴ Laser treatment also does not require an inpatient stay, so reducing patient costs. Indeed, uptake of treatment for glaucoma has improved dramatically since laser treatment became available: six years prior to the trial, when laser was not available, only 8% of 85 glaucoma patients offered surgery as the treatment of choice agreed to the procedure, and less than 2% finally underwent surgery⁴. Participants who underwent laser treatment in the trial may also have discussed their experiences with friends, family and community members, which increased the acceptability of laser treatment amongst those who subsequently attended the clinic, regardless of allocation. Other reasons for the higher than anticipated uptake of laser treatment in the usual care group could reflect improvements in the infrastructure, equipment, skills and motivation of trained staff since the pilot study, and the more informative educational pamphlet given to all participants.

Cultural factors are relevant to the interpretation of these findings. Uptake of treatment was higher among participants with higher levels of education, as has been shown previously.²³ However, uptake was not associated with severity of disease, even amongst those at imminent risk of blindness. The reason for this finding is not clear, as it is not uncommon for patients with advanced or end stage disease to lose hope, as highlighted in our earlier study.⁹ Professionals, despite their higher level of education, had lower uptake of surgery or laser, which may reflect lack of time or a preference for topical

treatment, which they can afford.

We have no data on fidelity to MI, which if low, may also explain the lack of effect. Motivational interviewing is complex and may require more and better training and supervision than was possible in this effectiveness trial.²⁴ The WAI data were not subject to linguistic restrictions, and the results showed encouragingly good concordance, although these self-reported data are subject to information bias.

Follow up of participants for treatment and research purposes continues to be a major challenge in rural Africa where many glaucoma patients never return after the first visit. Low cost approaches such as text message reminders, that have been used to improve follow up in trabeculectomy patients, may be employed.²⁵

The findings of this trial may be generalisable to other clinics that treat patients with glaucoma in this area, and potentially also elsewhere in Africa. However, it may not be generalisable to the general population where there will be many more people with undiagnosed, earlier glaucoma who may react differently to AMIG.

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Chapter 7: Transcleral Diode Laser

Cyclophotocoagulation case series

Transscleral diode laser cyclophotocoagulation has only been used in the management of refractory glaucoma until recently when its use has been extended to seeing eyes with glaucoma even as primary treatment.[79, 107, 113] Cyclodiode is effective for all types of glaucoma and can be carried out with few complications compared with traditional surgery. The effect can decline over time but it can be safely repeated. It is easy to teach and easy to learn. In facilities where cost is a major concern, it is a cost effective option as the laser can also be used to treat other conditions such as diabetic retinopathy, sickle cell disease, central retinal vein occlusion and retinopathy of prematurity. The initial cost outlay may be high but it is still much cheaper than other lasers, such as argon, and it requires little to no maintenance. The diode laser is small and portable, and can be transported with ease to treat patients even in outreach centres.

Current studies in seeing eyes have demonstrated the effectiveness of the laser in adequately controlling intraocular pressure and preserving vision in seeing patients. In patients with blind painful eye from refractory glaucomas such as neovascular glaucoma, it is very effective in providing pain relief. As it is an extraocular procedure, the risk of complications that are inherent in other incisional surgical glaucoma treatments is very low, as such it is good in areas where patient follow up is poor.

The following paper describes the findings from a pilot study of a cohort of patients with advanced glaucoma but with remaining vision who have been treated with cyclodiode as primary treatment. The data presented is the largest prospective series of African patients with seeing eyes treated with cyclodiode.

The source of the patients for this case series was patients attending the study hospital whether as primary patients or as patients referred from other neighbouring centres with or without a diagnosis of glaucoma. This case series includes glaucoma patients who were not part of the trial either because they were not eligible for the trial, were treated before recruitment started or after recruitment for the trial had ended. Details of the study are in the paper submitted for publication below.

1. Trans-scleral diode laser cyclophotoablation an alternative treatment for primary open angle glaucoma in black populations. Abdull MM, Evans J, Broadway D, Kyari F, Muazu F, Gilbert C.



Figure 13: Transscleral diode laser cyclophotocoagulation in progress

Paper 14: Trans-scleral diode laser cyclophotoablation an alternative treatment for primary open angle glaucoma in black populations

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SECTION A – Student Details

Student	MOHAMMED MAHDI ABDULL
Principal Supervisor	Clare Gilbert
Thesis Title	Adapted motivational interviewing to improve uptake of treatment in glaucoma patients in Bauchi stat, Nigeria

If the Research Paper has previously been published please complete Section B, if not please move to Section C

SECTION B – Paper already published

Where was the work published?	
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Please list the paper's authors in the intended authorship order:	Mohammed M Abdull, David C Broadway, Jennifer Evans, Fatima Kyari, Fatima Muazu, Clare Gilbert.
Stage of publication	Submitted, Under review

SECTION D – Multi-authored work

For multi-authored work, give full details of your role in the research included in the paper and in the preparation of the paper. (Attach a further sheet if necessary)	Planned the study, collected data, analysed data with others, made the first draft of the paper., Collected responses from others. Wrote the final draft after incorporating responses from others
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Student Signature: AShell

Date: 28/07/2017

Supervisor Signature: Clare Gilbert

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Safety and effectiveness of primary transscleral diode laser cyclophotoablation for primary open angle glaucoma in Nigeria: a pilot study

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ABSTRACT

Purpose

In Africa patients with glaucoma present very late, have poor medication adherence, low acceptance of trabeculectomy and poor follow-up. This study explored the safety and effectiveness of transscleral diode laser cyclophotocoagulation as a primary treatment for sighted eyes with primary open angle glaucoma.

Methods

Prospective case series of new patients with a presenting acuity $\geq 3/60$ where surgical intervention was recommended. A diode 810nm laser G-probe was used under retrobulbar anaesthesia to deliver approximately 20 shots for 2000ms, titrating the power on an individual basis. A second treatment was offered if the IOP was high ($>21\text{mmHg}$) on two consecutive visits. Main outcomes among first eyes treated: IOP of $<22\text{mmHg}$, change in ≥ 2 lines of Snellen acuity at 12 months, complications.

Results

17/204 (8.3%) first eyes treated had a second treatment. Mean age was 52 years, 69% were male. 107 (52.5%) attended at 12-months. Before treatment (202 eyes with data) mean IOP was 39 (SD11) mmHg being 12, 11, 15, 18, 19 and 19mmHg on day one, one week, and 1, 4, 6 and 12 months respectively. At 12 months 77 (72.6%) eyes (106/107 with data) had IOPs $<22\text{mmHg}$. At 12 months 83 (78 %) eyes retained (70 eyes, 66%) or had improved (13 eyes, 12%) visual acuity; 25 eyes (23%) lost acuity. Post-operative complications included mild, transient uveitis (5.9%), corneal oedema (2.2%), severe uveitis (0.5%), and transient hypotony (2.2%). Eyes treated twice had slightly higher complication rates. At 12 months no eyes had persistent hypotony.

Conclusions

Diode laser was effective in controlling IOP in almost three quarters of eyes at 12 months with short-term preservation of vision and minimal complications. Poor follow-up highlights the need for an effective, safe and acceptable treatment where regular follow up is less critical.

INTRODUCTION

Africa is the region with the highest prevalence of primary open angle glaucoma (POAG) affecting an estimated 7 million people aged 40-80 years.¹ The predisposition to POAG in Africa is likely due to variation in genetic susceptibility.² Furthermore, glaucoma is responsible for a higher proportion of blindness in Africa than in other regions (range 8-22.9%)^{3,4,5} being 16.3% in Nigerian adults aged 40 years and above.⁶

Glaucoma is more blinding in Africa than in other regions as it has an earlier age of onset⁷ with a longer life time risk of blindness. For example, in a study in the United States of America glaucoma began 10 years earlier in people of African descent than in Caucasians and was 6.6 times more frequent.⁸ In individuals of African descent, glaucoma also has a more aggressive course,⁹ which increases the lifetime risk of blindness. In Africa, most people with glaucoma present very late, often already blind in one eye^{10,11} and there is poor awareness of the disease.^{12,13} Services for eye care, particularly for primary eye care and for specialist glaucoma care, are inadequate with the latter being mainly located in major urban centres.^{14,15} A high proportion of the population are poor and cannot afford the cost of treatment or follow up.¹⁶ In addition, adherence to systemic or topical medication is often low^{11,17} as is acceptance of glaucoma surgery since this does not improve visual function,¹¹ and patients are fearful of undergoing surgery on their only seeing eye. Even though trabeculectomy can provide stable and long term IOP control in people of African origin,¹⁸ ophthalmologists in Africa¹⁹ are often reluctant to offer trabeculectomy for fear of complications, including visual field “wipe-out” in advanced cases²⁰ and the known variable outcomes in Africa.²¹⁻²⁵

There are only a few studies comparing the outcome of surgical interventions for glaucoma in patients of African descent, including laser procedures.^{26,27} In a recent review, the authors concluded that there was no evidence that any procedures are superior to trabeculectomy in eyes of patients of African descent, and there is compelling evidence that the outcomes of trabeculectomy are less good than for Caucasian eyes, particularly if antimetabolites are not used.²⁸ Given the relatively low uptake of surgery, poor outcomes and inadequate follow up, laser treatment could be considered as a primary treatment for glaucoma in Africa despite the limited reported evidence.

In our pilot study, we chose transcleral diode laser cyclophotocoagulation (TDLC) as the modality of choice given the ease of delivery, the relatively low cost of the laser and

accessories, together with low maintenance costs. Diode lasers can also be used for a range of other eye conditions so lowering unit costs and hence costs to patients. All these factors make may make TDLC a feasible and scalable option, particularly in low-income settings with very few glaucoma specialists.

In a published review of 18 studies of TDLC treatment, the number of eyes treated ranged from 8 to 263, and follow up ranged from 9 to 66 months.²⁹ The studies had different indications for treatment and often included different types of glaucoma. The proportion of eyes in which intraocular (IOP) was controlled (i.e. <22mmHg) ranged from 38% to 88.1% (in 13 studies reporting this outcome).²⁹ There are only a few studies of TDLC for seeing eyes, or as a primary treatment, or which were undertaken in Africa.

With respect to studies on seeing eyes (Table 1A and 1B), in a retrospective study in the UK, the indication for treatment was uncontrolled glaucoma on maximal medical treatment: among the 46 eyes treated, 52% had POAG, the mean pre-treatment IOP was 24 (12-35mmHg) and at 2 years 80% of eyes had an IOP of <22mmHg with or without additional topical treatment: 23.9% of eyes lost more than two lines of VA³⁰. In another UK study, 49 seeing eyes were treated for uncontrolled glaucoma and at five years IOP was controlled (6-21mmHg) in 79.6% of eyes; 30.6% lost ≥ 2 lines of VA.³¹

Primary treatment for glaucoma using TDLC has been reported in several studies, most of which are prospective or retrospective case series (Table 1A and 1B). For example, a study in Germany recruited individuals who refused surgery or where follow up could not be guaranteed: among the 25 eyes treated, retreatment was required in 3 eyes.³² In another study of primary treatment for a range of different types of glaucoma in Germany, 193 eyes were treated: at follow up 90% of eyes with POAG had IOPs of 10-22mmHg after single or multiple treatments.³³

There are only four studies reporting TDLC treatment outcomes in Africa, from Cameroon,³⁴ Malawi,³⁵ Ghana³⁶ and Tanzania,³⁷ which had different indications for treatment, varying outcomes, small sample sizes and poor follow up.

TDLC laser treatment is relatively safe, with mild anterior uveitis immediately after treatment being the commonest complication reported (Table 1). The reported complications of TDLC include mild anterior uveitis following the treatment. Other less common complications reported following TDLC include conjunctival or scleral burns, hyphaema, atonic pupil, choroidal detachment and hypotony, which in some cases are

related to decreased vision following the treatment. Table 1 presents the complications leading to the reduced vision identified in some studies. Most of the more serious complications were in studies which included patients with intractable or complex glaucoma.

Tables 1A and 1B

The purpose of this prospective pilot study was to explore the safety and effectiveness of TDLC treatment for POAG in the seeing eyes of African patients with POAG. The study was undertaken in a tertiary level eye department in north-east Nigeria.

Table 1A. Transscleral diode laser cyclophotocoagulation treatment studies: indications for and methods of treatment, participants and outcome measures

Author, country (ref)	Study design	Type of glaucoma	Indications for treatment	Number treated	Definition of outcome	Preoperative IOP (mmHg) (range)
Studies in Africa						
Egbert, Ghana ⁴¹	Trial of laser power	POAG	Primary treatment	92 eyes	Final IOP <22 mm Hg	Mean 29.3 (16-66)mmHg
Mavrankanas, Tanzania ³⁶	CS - retrospective	POAG (seeing and non seeing)	Uncontrolled IOP	49 eyes	Lower IOP	Mean 53mmHg
Preussner, Cameroon ³³	CS - prospective using 910nm laser	POAG	IOP reduction; reduction in medication	272 eyes; 26 followed up	IOP reduction at 1 year	Mean 31.2mmHg
Schulze, Malawi ³⁴	CS - prospective	POAG; PXE	IOP reduction	47 eyes	Mean IOP reduction	Mean 38.5mmHg
Studies in other countries						
Rotchford, UK ³⁰	CS - retrospective	POAG seeing eyes	Primary treatment	49 eyes	Loss of 2 or more VA line IOP 8-21	28mmHg (16-50)
Ghosh, UK ²⁹	CS - prospective	POAG seeing eyes	High IOP	46 eyes	24 months follow up	Mean 24mmHg
Kuchar, USA ⁴²	CS - prospective (micropulse laser)	Advanced	Uncontrolled IOP	19 eyes	6-21 mmHg/20% lower at last visit	Mean 37.9 mmHg
Butt, Pakistan ⁴⁰	Quasi-experimental	POAG	POAG on maximum medication; Primary Rx	60 eyes	IOP reduction	Mean 41.62 (28 – 60) mm Hg
Bloom, UK ⁴³	CS - prospective. YAG laser	Any type	Refractory glaucoma after multiple procedures	45 eyes	Not defined	Mean 32mmHg
Ansari, UK ⁴⁴	CS - retrospective	Non refractory	Poor control; painful, blind eye allergies; refused surgery;	74 eyes	Lower IOP fewer medications	Mean 40.3mmHg
Spencer, UK ⁴⁵	CS - prospective	Refractory	Uncontrolled IOP: surgery refused or unlikely	58 eyes	Reduction in glaucoma medicines	Mean 33.0 mmHg
Martin, UK ⁴⁶	CS - prospective	Painful blind eyes	Pain	30 eyes	IOP reduction; pain	Mean 51 mm Hg

					relief	
Kramp, Germany ³²	CS - retrospective	109 POAG; 84 secondary	Uncontrolled glaucoma	193 eyes	IOP 10-22 mmHg	Mean 24.6+/-6.7 mmHg
Murphy, UK ⁴⁷	CS - retrospective	Refractory: 46% neovascular	Uncontrolled glaucoma	263 eyes	IOP <22 mm Hg or > 30% drop in IOP	Mean 40.7 mmHg
Lai, Hong Kong ⁴⁸	CS - prospective	CACG	Medical uncontrolled CACG	13 eyes	IOP <21mmHg with or without medication	Mean 36.4 +/- 12.6 mm Hg
Grueb, Switzerland ⁴⁹	CS - retrospective	POAG, PXEG	POAG, PXEG	90 eyes	4-18mmHg or 20% reduction	Mean 21 mmHg (12-36 mmHg)
Vernon, UK ⁵⁰	CS - retrospective	Refractory; 19% 19%	Poor control	42 eyes	IOP<22; reduction in medicine	Mean 31.4mmHg
Iliev, Switzerland ⁵¹	CS - retrospective	Advanced, refractory: 3% POAG; 61% neovascular	Refractory glaucoma	131 eyes	IOP 6-21 at last visit	Mean IOP 36.9mmHg
Raivio, Finland ⁵²	CS - retrospective	1/3 PXE; POAG/complex	Poor control; refractory glaucoma	60 eyes	8-21mmHg	IOP 27 ± 11 mmHg
Frezzoti, Italy ⁵³	CS - prospective	Advanced/refractory: 36% POAG; 64% complicated	Refractory	124 eyes	IOP 5-21; pain relief	Mean 29.9 +/- 8.4 mmHg (17-58 mmHg)
Zhekov, UK ⁵⁴	CS - retrospective	Refractory. One treatment only. 45 POAG/PACG	IOP maintained; visual acuity	87 patients	Not defined	IOP 39.5mmHg

CS = case series; IOP = intraocular pressure; POAG = primary open angle glaucoma; PXEG = primary exfoliative glaucoma; CACG = chronic angle closure glaucoma

Table 1B. Transscleral diode laser cyclophotocoagulation treatment studies: outcome of treatment and complications

	Follow up	Outcome: Post op IOP	Outcome: Visual acuity (change)	Complications (n) number of eyes	Comments
Studies in Africa					
Egbert ⁴¹	Mean 13.2 months	≥20%mmHg drop in 47%; 48% final IOP <22 mm Hg	Worse in 23% but not defined	Atonic pupil (92) 28%; transient hyphaema (3), severe iritis (2). No hypotony, phthisis or sympathetic ophthalmia.	
Mavrakanas ³⁶	Variable	At last visit 51% eyes had >50% lower IOP	Not reported	No serious complications	
Preussner ³³	1 year, 26 eyes	Mean reduction: 7.5mmHg	Not reported	No serious complications	Medication reduced from 1.5 to 1.2.
Schulze ³⁴	3 months	Mean 35.6mmHg	Not reported	Atonic pupil (4) 10.6%; transient iritis (1) (2.1%)	Low dose diode used
Studies in other countries					
Rotchford ³⁰	5 years	79.6% controlled at final follow up	≥2 lines: worse 30.6% (15 eyes): 9 glaucoma progression.	Vitreous haemorrhage (1); retinal detachment (1); macula oedema (4)	
Ghosh ²⁹	24 months	Mean 17.2 (12-28); 84.8% IOP<21mmHg	>2 lines: same 76.1%; worse 23.9%; (11 eyes); 9 glaucoma progression.	Macula hole (1); retinal detachment (1); macula oedema (2). No hypotony.	
Kuchar ⁴²	Mean 60.3 days	22.7 mmHg at last follow-up, 40.1 % decrease.	One line of VA: better 21%; worse 21%.	Hypotony (1).	
Butt ⁴⁰	12 months	Mean 15mmHg at 6 mon; 14.15mmHg at 1 year	Not reported	Anterior uveitis, cataract (8) 13.3% each; hyphaemia (5) 8.3%; hypotony (6) 10%	45% of eyes retreated. 6% had three treatments.
Bloom ⁴³	No data	Mean 19.3mmHg. 71% treatment success	≥2 lines: worse 9%	Phthisis(1); chronic hypotony(2); hyphaema and vitreous haemorrhage (1)	
Ansari ⁴⁴	12.5 (4-30) months	Mean: reduced by 45.1% to 21.1 mmHg at final visit.	Mean VA preserved in those with good VA; worse in 13% (glaucoma progression; lens opacity,	Hyphaemia (3); chronic iritis (3); corneal oedema (1). No hypotony or other serious complications.	58% reduction in medication. All with iritis had peripheral iridectomy

			chronic uveitis)		
Spencer ⁴⁵	Mean 19 (6-37) months	Mean 16.7 mm Hg at final visit	>2 lines: worse 32%	Rubeotic eye developed endophthalmitis. Chronic hypotony (2) no phthisis (8) 13.3%	Fewer medications: from 2.4 to 1.4. Up to 5 treatment sessions
Martin ⁴⁶	6 months	26 mm Hg. Pain relief in 73.3%	Not reported	Hypotony (3); phthisis (1); uveitis (2); hyphaema (1)	
Kramp ³²	Mean 13.9 (6 to 48) months	Success 76.4%. Mean 19.3+/-5.7 mmHg. Best results in POAG	No reported	Mild anterior uveitis (31); hyphaema (1); phthisis bulbi (3)	≤6 sessions. 2 phthisical eyes had neovascular glaucoma and PXG
Murphy ⁴⁷	17 months (6-46)	Mean 17.7 mmHg. Reduction of 52.6%. Success 89%	Not reported	Hypotony ranged from 0% in POAG to 18.8% in uveitic glaucoma. Persistent uveitis 1.6%; most in complicated glaucoma	A third of eyes were retreated
Lai ⁴⁸	Mean 26.5 (+/- 4.2) months	Success 92.3%. Mean 18.7 +/- 12.2 mm Hg at final visit	≥2 lines: same 15.4%; better 46.2%; worse (5 eyes).	No hypotony. Atonic pupil (7)	
Grueb ⁴⁹	≥24 months	Mean 16 (9-27) mmHg. Success 36.7% all 40.9% POAG	Not reported	Hyphaema (1); anterior uveitis (10). No phthisis.	
Vernon ⁵⁰	Mean 65.7 (36-84) months	88.1% success. 50.3% reduction in IOP. Mean 15.6 +/- 6.3 mmHg	Same 26.2% Better 9.5% Worse 64.3%	Transient hypotony (2)	Fewer medications: from 2.6 to 1.7. ≤6 sessions. Focus on maintaining acuity
Iliev ⁵¹	Mean 30 months (no range)	Success in 69.5%. 45.8% IOP controlled with 1 treatment	Not reported	Hypotony (23) 17.6%. 74% of these eyes had neovascular glaucoma. Chronic uveitis (1); severe dry eye (1); hyphaema (1) vitreous haemorrhage (1).	Fewer medications: mean from 2.97 to 1.39. Multiple eyes were retreated.
Raivio ⁵²	26 (3-75) months	18±5mmHg at 6months, 19±7mmHg at 1year, 80% had 30% reduction in IOP at last follow up	Not reported	Mild anterior uveitis 25%; hyphaema (2 eyes), vitreous haemorrhage (1). No hypotony.	
Frezzoti ⁵³	17 (3-42) months	20.8mmHg (range 6-45) last visit	Loss of two or more lines: 12.9%	Mild anterior uveitis (3) 2.4%; hyphaema (2) 1.6%. No hypotony or phthisis	

Zhekov ⁵⁴	3 years	17.8mmHg at 6 weeks maintained over 3 years	Same or better: 83.6%	Hypotony 5%; no uveitis	
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IOP= intraocular pressure

PATIENTS AND METHODS

Ethical approval was obtained from the ethics committee of the London School of Hygiene & Tropical Medicine and from the institutional review board of Abubakar Tafawa Balewa University Teaching Hospital (ATBUTH), Bauchi, Nigeria. The study adhered to the tenets of the Declaration of Helsinki.

Glaucoma was diagnosed on the basis of vertical cup-disc-ratio (VCDR), IOP and visual field analysis, where possible, in patients attending ATBUTH eye clinic. Presenting visual acuity (VA) was measured in each eye using a Snellen E chart and categorized using World Health Organization definitions. New patients with a range of severity of POAG but who had a VA of 3/60 or better in one or both eyes were recruited for primary treatment. The following patients were not recruited: previous glaucoma surgery; those who were already blind from glaucoma in both eyes (VA of less than 3/60) and those who preferred to use topical medication. Given local fears about eye surgery, particularly on only seeing eyes, the laser treatment was explained as “computer light treatment”. Data are presented on individuals who had a presenting VA of 3/60 or better in the treated eye and who were followed up for a minimum of 12 months.

After obtaining written consent, retrobulbar anaesthesia with lignocaine and adrenaline 2% was administered. Treatment was performed in the operating theatre using the G-probe of the Iridex diode 810nm laser (Iridex Corporation, 1212 Terra Bella Avenue Mountain View, CA 94043, USA) in continuous mode. The probe heel was placed at the edge of the limbus matching the contour of the scleral curvature so that the small 0.7mm protrusion indented the sclera approximately 1.2mm posteriorly to optimize energy delivery at the site of the ciliary body. Approximately 20 shots were delivered for 2000ms, titrating the power to just below an audible pop to reduce the risk of inflammation and postoperative hyphaema.⁵³ Treatment was given over 360 degrees, avoiding the ciliary vessels at the 3 and 9 o'clock positions. A sub-conjunctival injection of dexamethasone 2mg was given and the eye padded for an hour. Oral diclofenac potassium 50mg was prescribed twice a day and G. dexamethasone 0.1% four times a day for one month, tailing off thereafter over a few weeks. On the first post-operative day, VA was measured using a Snellen E chart, patients underwent slit-lamp biomicroscopy for signs of complications such as inflammation or hyphaema and IOPs were measured using Goldmann applanation tonometry.

Patients were reviewed at one day, one week and at one, four, six and 12 months after treatment when VA and IOPs were measured. Anterior segments were examined at the slit lamp for complications at each visit. Patients were given dates to return for follow up but were not actively traced. If the IOP was raised ($>21\text{mmHg}$) at follow up topical medication was initiated and if the pressure was still high at the next visit TDLC retreatment was offered. A second session of laser was given to those who consented.

The outcomes of the study were IOP control, defined as less than 22mmHg , change in VA, defined as at least two lines change in Snellen VA, and follow up rates. Absolute measures of IOP were used to define control rather than a % reduction given the very high IOPs at presentation (72% of eyes were treated when their IOP was $>30\text{mmHg}$ and 40% had IOPs $\geq 40\text{mmHg}$).

Data management

If both eyes were treated, the first eye was included as the study eye. Data were entered into a database created with Epidata and exported into Stata/IC 14.1 statistical software (StataCorp LP TX 77845 USA) for descriptive analysis. Follow up, IOP and VA findings at baseline and on the first postoperative day, at one week and at one, four, six and 12 months are presented.

RESULTS

204 seeing eyes with glaucoma which had not previously had surgical or laser treatment underwent TDLC. 17 (8.3%) eyes were retreated. The average power setting was 1770mW (range $1100\text{--}2300\text{mW}$) with duration of 2000ms. The average number of laser spots delivered per eye was 20 (range 15-25).

The mean age of the 204 patients was 52 years (range 12-85 years) and 69% were male. The mean vertical cup disc ratio (VCDR) in treated eyes at presentation was 0.9 with 44% having a VCDR of 1.0. Visual field analysis was only possible in 65 (32%) eyes

Not all patients attended every follow up (Table 2). A total of 107 (52.5%) were followed up at 12 months. Rates of follow up were higher in males than females at 12 months (69% and 31% respectively) at each follow up visit. Follow up did not differ by age.

Table 2: Baseline and post operative IOP and topical medication use after TDLC treatment

		Number followed up			IOP (mmHg)			<22mmHg (eyes with IOP data)		On topical medication	
	Eyes	%	With IOP data	Without IOP data	Mean	SD	Range	N	%	N	%
Baseline	204	100.0%	202	2	39	11	22-72	0	0%	0	0%
1 day	199	97.5%	191	8	12	5	2-30	178	93.2%	1	1%
1 week	184	90.2%	177	7	11	5	1-28	163	92.1%	5	3%
1 month	162	79.4%	156	6	15	7	1-48	130	83.3%	16	10%
4 months	137	67.2%	131	6	18	9	2-50	100	76.3%	16	12%
6 months	118	57.8%	116	2	19	8	3-52	86	74.1%	14	12%
12 months	107	52.5%	106	1	19	7	7-45	77	72.6%	11	10%

Intraocular pressure

In some eyes IOP could not be measured at baseline and follow up due to marked corneal oedema, pain or poor cooperation. The mean IOP before treatment (202/204 eyes) was 39mmHg (SD 11mmHg; range 22-72mmHg)(Table 2) and the median was 37mmHg (interquartile range 29-46mmHg). On the first postoperative day, the mean IOP was 12mmHg, being 12, 11, 15, 18, 19 and 19 (range 7-45)mmHg on day one, at one week, and 1, 4, 6 and 12 months respectively. At 12 months 72.6% (106/107 eyes with data) of treated eyes had an IOP of <22 mmHg. The proportion of eyes on topical glaucoma medication at follow up visits ranged from 1% to 11% over the 12 months, being 10% at 12 months.

Findings were very similar for eyes having only one session of laser treatment (187 eyes), with 73.7% (99 eyes) having an IOP of <22mmHg. Mean IOP at 12 months was 19 (range 7-45) mmHg.

There was no significant association between final IOP and initial IOP. There was also no association between final IOP with laser energy used nor on the number of laser spots delivered. There were no age or gender differences in IOP at baseline or at 12 months.

The mean pre-treatment IOP in those with complete one year follow up (mean: 37mmHg, range 12-72mmHg) was similar to the total population.

Visual acuity

The majority of eyes (83/106 eyes with data), 78%) either retained their baseline VA (70, 66%) or had improvement by two or more lines (13, 12%). Visual acuity deteriorated by two or more lines in 25 eyes (23%): these eyes had a slightly higher IOP before treatment (mean 41mmHg, range 26-72) than eyes not losing acuity (mean 37mmHg, range 22-60). At 12 months the mean IOP in the eyes that lost vision was 29mmHg (range 8-45) compared with 19mmHg (range 7-30) in eyes not losing vision. In addition, 12 (52%) of eyes losing vision had a VCDR of 1.0 before treatment compared with 28 (39%) of eyes not losing vision. Four eyes losing vision had progression of cataract, and 6 had persistent corneal oedema. Visual loss in the remaining eyes was due to glaucoma progression.

Safety and complications

A few patients had mild anterior uveitis on the first postoperative day, which resolved with topical steroid therapy (Table 3). No eyes developed hyphaema or other serious complications. Transient hypotony i.e., IOP of <6 mmHg, developed in four eyes during follow up but this did not persist at one year. Eyes which were retreated had slightly higher complication rates, with one eye developing severe uveitis.

Table 3. Complications after first and second treatment with transscleral diode laser cyclophotocoagulation

Complications	First treatment (204 eyes)		Second treatment (17 eyes)	
	N	%	N	%
Mild anterior uveitis	11	5.9	2	11.8
Severe uveitis	1	0.5	1	5.9
Hypotony (<6mmHg) - temporary	4	2.2	0	0
Hypotony (<6mmHg) - persistent	0	0	0	0
Corneal oedema	5	2.7	1	5.9
Cataract progression	4	2.2	0	0

DISCUSSION

This is the largest case series of TDLC as a primary treatment for seeing glaucomatous eyes in Africa. Unlike other studies from Africa the inclusion criteria were clearly defined as were the outcomes. A standard treatment protocol was used and all treatments were delivered by one ophthalmologist who had undergone TDLC training in the United Kingdom. The proportion of patients reaching 12 months of follow up was reasonable. TDLC was effective at attaining IOP <22mmHg in a high proportion of treated eyes, the majority of whom did not require additional treatment, with good preservation of VA in the short term. The findings of the present study need to be considered in the context of the patients included (i.e., as an alternative to those who did not accept incisional surgery or who consistently did not adhere to topical medication, or where it was anticipated that they would not return for regular follow up after surgery). Laser treatment was, therefore, offered to patients where it was considered the only viable alternative. As in other TDLC studies, immediate post-treatment complications were minimal, but were slightly higher in retreated eyes.

There was good acceptance of TDLC treatment, which may be explained by the term used to describe it, which avoided the local Hausa term for surgery, “fidar ido”, which means “butchering”. The treatment was described as ‘computer light treatment’ presented as a once-off, but repeatable treatment, which is desirable in settings where there is a fear of surgery and hospitalization, and where there is not a culture of attending follow up appointments. For service providers the TDLC procedure is easy to learn and the solid-state laser used is cheaper, reliable and more versatile than other

lasers.

Poor follow up of patients is a challenge in the delivery of glaucoma care in Africa, as in this study, where patients either did not return for follow up at all, or did so at irregular intervals. Despite this, in our study over half returned at 12 months which was a marked improvement in comparison with previous findings in the same hospital.¹¹ However, poor follow up may have biased the findings, since a greater proportion of those who did not return may have lost vision and lost faith in healthcare. Having stated this, however, it might have been that a greater proportion of patients in whom vision had stabilised or improved failed to return, believing that they were 'cured'. The poor follow up rates emphasizes the need in rural Africa for a procedure that maintains IOP, which has few postoperative complications and where regular follow up is less critical. The present study suggests that follow up at 4 months may be an important time to detect those where treatment has failed to adequately control IOP.

Comparison of our findings with other studies from Africa is difficult given the variation in study design, indications for and methods of treatment, outcome definitions and follow up rates (Table 1). For example, the study in Ghana was a clinical trial to assess different laser power settings. Treatment was offered as a primary treatment and 92 eyes were treated: at three months 38 of the 79 patients who attended (48%) had an IOP of 22mmHg or less; 16 of these eyes had been retreated with laser and topical medication was being used in 68 eyes.³⁶ The study in Tanzania was a retrospective review of 179 treated eyes only 49 of whom had at least one follow up visit. At the 3-6 month follow up 4/12 eyes had an IOP of 21mmHg or less and 9 eyes were retreated.³⁷ The study in Cameroon used a 910nm laser (not the usual 810nm laser) to treat 272 eyes but only 26 were followed up at 12 months when the average IOP reduction was 7.5 mmHg, this being lower than in our study.³⁴ In the Malawi study, a low dose of 900mW (instead of the more usual power of approximately 2000mW) was used to treat POAG and pseudoexfoliative glaucoma. At 3 months mean IOP had fallen from 38.5mmHg to 35.6mmHg and in 50% of treated eyes the IOP returned to pre-treatment levels.³⁵ These poor outcomes are probably explained by the low power setting used.

Most glaucoma patients of African ancestry lose vision rapidly if they are not treated or have poor IOP control.⁵⁴ In our study the majority of treated eyes either maintained their baseline VA or their acuity improved. The latter may be explained by resolution of corneal oedema in eyes with very high IOPs.

Complications following treatment were minimal in the present study, and compared well with other studies on seeing eyes (Table 1). TDLC has had a relatively bad press in industrialized countries since it is frequently offered as the treatment of last resort or for eyes with complicated, intractable glaucoma. Failure rates and high complications rates are much more likely in these eyes which will have had multiple procedures and many will have had refractory glaucoma (e.g. secondary to rubeosis etc.)⁴⁹ than in those where it was used as a primary treatment, as in the present study. In the present study, the majority of patients whose vision deteriorated suffered the results of age-related processes such as cataract progression, or progression of glaucoma in end-stage, elderly eyes, rather than as a direct result of the procedure itself.

In the present study the target used to define control was an IOP of <22 mmHg, a target used in other studies. However, the natural history and optimal target IOP to control glaucoma in Africa is not known. A further limitation of this study was that visual fields, vertical cup:disc ratios and other parameters were not used to monitor disease progression. There are several reasons for the limitations. Firstly, reliable assessment of visual fields is very difficult amongst uneducated African patients, many of whom have extensive visual field loss and are not familiar with interacting with technology. Second, many patients had corneal oedema at baseline, which precluded baseline optic disc imaging, and lastly, optical coherence tomography was not available, which would have provided objective data to monitor structural changes at the optic nerve head. However, monitoring optic disc change in eyes with very advanced disease would be challenging, as in the present study, where almost half the eyes had a cup:disc ratio of 1.0 before treatment. The present study had a number of other limitations, including the relatively small sample size and limited follow up rates, as discussed above.

The authors suggest that the findings of the present study are generalisable to other parts of Africa where challenges faced by most glaucoma patients are similar. A recent review of TDLC treatment concluded that this form of treatment is effective at lowering IOP and reducing the need for medication. TDLC is a simple, quick, minimally-invasive therapy which is worth considering by general ophthalmologists as a primary treatment⁵⁵ or as an alternative to surgical interventions in low-income settings. The findings of the present study suggest that TDLC could be an alternative primary treatment in an African setting. TDLC appeared to be acceptable, provided reasonable IOP control after one session and preserved vision at least in the short term, for patients who would otherwise

have remained without treatment, and confirmed that TDLC is convenient and well tolerated.⁴⁰

Implications for service delivery / research

The similarity of the results in the present study with other studies around the world, the low cost, acceptability and ease of delivering TDLC laser treatment, offers some promise in the otherwise bleak landscape of glaucoma control in Africa. Given that a once-off treatment is the desired approach to glaucoma control, clinical trials are needed to compare the efficacy, acceptability, cost and safety of other forms of laser treatment as a primary treatment for glaucoma. Future studies of glaucoma in Africa need to use standard definitions of control together with robust methods to assess disease progression in terms of structural and functional parameters, with adequate sample sizes to allow for loss to follow up.

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Chapter 8: Implications of the findings for programmes, policy and further research

The majority of people with glaucoma in Africa only present to eye care facilities when they have symptoms of loss of vision in at least one eye, and many patients continue to go blind because of poor adherence to medical treatment, poor acceptance of surgery and failure to attend for regular follow up. In an attempt to delay blindness, MI was used to test the hypothesis that it would increase the uptake of surgery or laser treatment. The interview was adapted to the local language and customs to make it more acceptable to patients. Although there was an overall increase in acceptance compared with the period before the trial, there was no statistically significant difference between the intervention and usual care arms of the trial.

There are many possible reasons why MI did not have the desired effect. Firstly, MI may not have been delivered well or accepted in the right spirit by participants. The counsellors who delivered MI may not have acquired adequate skills as they did not undergo formal training. A limitation of the trial was that only one interview could be assessed for fidelity using MITI (during pilot testing), and further assessment was not possible as all interviews conducted during the trial were in Hausa or Pidgin English which the assessors could not understand. The WAI questionnaire did however, show that good collaborative relationships developed between interviewers and participants. Cultural attitudes and practices are also likely to be relevant. Professional or formal counselling only became widespread in Africa as a result of HIV, and may have had negative connotations for some. Others were reluctant to open up, seeing MI as something foreign and an intrusion into their private lives, as they were required to share intimate life experiences or beliefs with a total stranger, who was not even their doctor. However, for others it was a novelty, which they were keen to participate in, seeing it as an opportunity to be listened to and have their questions answered. In this study participants were offered a second session of MI but none returned. These individuals were not asked why they did not return which might be because they were completely satisfied with one session, or they felt it was not valuable and did not wish to repeat it.

The primary outcome of the trial fails, what is the way forward?

“An unreasonable yet widespread practice is the labeling of all randomized trials as either positive or negative on the basis of whether the p value for the primary outcome is

less than 0.05. This view is overly simplistic. P values should be interpreted as a continuum wherein the smaller the p value, the greater the strength of the evidence for a real treatment effect.” (Pocock et al (*N Engl J Med* 375(9): page 861[257]). In this paper Pocock described 12 questions that should be asked to map the path forward if the primary outcome of a clinical trial carried out fails to give a statistically significant result. We attempt to answer these questions in relation to this study.

1. Is There Some Indication of Potential Benefit?

There is an indication of potential benefit as seen in the overall improvement in uptake of surgery as a higher proportion of patients underwent surgery or laser in the intervention arm than in the enhanced usual care arm.

2. Was the Trial Underpowered?

The sample size of the trial was calculated based on the pilot study where the number undergoing treatment was 50% higher in the MIG group than in the control group i.e., 300, with 150 in each arm of the trial. The sample actually recruited (276 participants) fell short of the calculated sample size. If the sample size of 300 had been achieved, the difference between the two arms of the trial would still not have been statistically significant with the current proportions of participants undergoing surgery or laser (OR 1.58, $p=0.208$).

3. Was the Primary Outcome Appropriate (or Accurately Defined)?

The primary outcome was appropriately defined and very objective i.e., whether patients underwent surgery or laser within 2 months of date given.

4. Was the Population Appropriate?

The patient population recruited was appropriate.

5. Was the Treatment Regimen / Intervention Appropriate?

There are still questions to answer about the appropriateness of counselling in this counselling naïve environment. In the past there has been stigma associated with counselling because of HIV/AIDS and also mental illness and addiction. This may have made patients defensive or anxious about the intervention. Was MI the right intervention to offer? For a location where there were no specialist trained counsellors, the literature suggested that this was a counselling technique that could be taught with reasonable fidelity to mid cadre workers[205, 258, 259] and could work in ethnic communities. Secondly, was the dose of the MI given enough? One treatment session only was given in this study because in the pilot study none of the patients offered a second session returned. Reasons for this were not explored but the implications are that they were either completely satisfied with one session, or they felt that the session was either not helpful or not a good use of their resources. The MI sessions varied in length

and this was left up to the interviewer. Thirdly, did the sessions deliver MI of high quality? Unfortunately it was not possible to quantify or substantiate whether the interviews followed the true MI spirit as it was not possible to carry out fidelity testing to assess the quality of interviews. The Working Alliance Inventory test may not have been a very objective measure of true collaboration as it relies on self-report and hence is subjective. Patients and interviewers can as well be nice to each other and rate the collaboration very high regardless of what they truly felt. One point to mention is that introduction of MI to the clinic may have altered the way staff interacted with all patients, with the routine explanation of the disease, its management and prognosis being given in a more empathetic manner. This may have led to greater uptake of treatment overall, including in the non-intervention arm.

6. Were There Deficiencies in Trial Conduct? A true treatment effect may be diluted, or disappear entirely, if there is poor adherence to the study protocol.

The trial was conducted according to the protocol and there were no protocol deviations. The possibility of contamination cannot be completely ruled out in this trial even though efforts were made to prevent this. For example, interviewers asked patients not to discuss whether they had had an interview with staff and other patients but this may have been ignored by some patients as all sat in the same waiting area in the clinic. We found no practical way to separate the two groups without un-masking project staff.

7. Is a Claim of Noninferiority of Value?

No relevant to this trial.

8. Do Subgroup Findings Elicit Positive Signals?

Subgroup analysis was not carried out as this was not planned and the sample size was not calculated to provide adequate power for subgroup analysis.

9. Do Secondary Outcomes Reveal Positive Findings?

There is a plan to carry out secondary outcome analysis, but as follow up is poor it is unlikely that this analysis will be adequately powered to give statistically significant differences.

10. Can Alternative Analyses Help?

Some covariate-adjusted analyses of baseline variables strongly related to the primary outcome were undertaken but these did not change the general results, although they showed some interesting relationships.

11. Does More Positive External Evidence Exist?

There is a body of evidence of the effectiveness of MI for a range of conditions but there is no evidence that it is effective in improving adherence to treatment in glaucoma care in the few studies carried out.[260-263]

12. Is There a Strong Biologic Rationale That favours the Treatment?

Not relevant to this trial

Improving the Design of Future Trials of MI for glaucoma in Africa

Future trials of MI for glaucoma could benefit from the lessons learnt in this trial in terms of the design and implementation.

1. Provide formal training in MI for all the interviewers to ensure that they attain high levels of competence, and deliver MI in the spirit of compassion, autonomy, collaboration and evocation.
2. Improve fidelity testing of MI interviews, which could be done by someone local after formal training. This would mean that fidelity testing could be undertaken on transcripts in the local language, which would reduce the risk of loss of insights as a result of translation into English. To avoid bias, however, the trained assessor should be someone independent of the trial.
3. Include or use other counselling techniques. There is evidence that MI augmented by other counselling techniques seems to give better long lasting outcomes, as it is generally believed that MI prepares people for change and to achieve this change and maintain it, other interventions, such cognitive behaviour therapy, may be needed.[264, 265]
4. Increase the sample size to allow for loss to follow up and to enable smaller differences to be detected, if they exist. However, a larger sample size would increase the logistical challenges and cost.
5. The study population and the primary outcome could remain the same, as both are robust and objective.
6. Make efforts to prevent or reduce contamination. One way to do this would to prevent contact between patients who had MI and those who did not by varying the waiting areas in the clinic or the appointments dates. However, this may be logistically challenging for a poorly staffed clinic and increases the risk that staff would become unmasked to the groups the patients were allocated.
7. Active follow up would be required, particularly to obtain data on secondary outcomes.

A multicentre trial would increase the generalisability of the findings.

Second, laser treatment, which was introduced before the trial started, was probably the single most important factor responsible for the far higher overall acceptance of treatment compared with the period before the laser was available. However, the pilot

study, which informed the sample size calculation, was done after laser treatment was introduced. The novelty of this new treatment, and the colloquial name given to describe it (“computer light”) may have overshadowed any incremental benefit of MI.

The effectiveness of TDLC in our study was similar to studies in many other countries, suggesting that TDLC could be an alternative primary treatment for glaucoma: it is acceptable to patients many of whom would otherwise be without treatment, gives reasonable IOP control after one session with no other treatment, and preserves vision at least in the short term. There are also advantages to clinicians, as TDLC is easy to learn, deliver and teach, it is safe and quick and can be done as a day case as it is minimally invasive, and it can be repeated, if necessary. Running cost are very low after the initial outlay, making it affordable to institutions and paying patients.

The findings from this cohort of patients may be generalisable to other parts of Africa where the challenges faced by most glaucoma patients and their clinicians are similar. General ophthalmologists could consider using TDLC as a primary treatment, particularly in rural areas. Other advantages of diode laser are that it is portable and versatile as it can be used to treat other eye diseases and so offers promise in the otherwise bleak landscape of glaucoma control in Africa.

In an attempt to scale up TDLC the researcher has trained five ophthalmologists in the National Eye Centre in Kaduna, Nigeria, which is the major teaching hospital for ophthalmology. These ophthalmologists have in their turn trained their residents. The feedback so far has been very positive, as the treatment was very acceptable to patients many of whom had sustained IOP control for the first time.

Implications for research in TDLC

Given that a once-off treatment is the desired approach for glaucoma control in Africa, clinical trials are needed to compare the efficacy, acceptability, cost and safety of laser treatment as a primary treatment. As the drive is for a once off minimally invasive procedure that is effective, a clinical trial comparing the effectiveness and safety of TDLC against more evidence based laser treatments, such as trabeculoplasty, are recommended. High quality trials of TDLC are needed as most published studies are of poor quality, and TDLC is currently seen as treatment of last resort, or only for blind painful eyes.

Future trials of laser treatment for glaucoma in Africa need to use standard definitions of control together with robust methods to assess disease progression in terms of structural and functional parameters, with adequate sample sizes to allow for loss to follow up. A study design to consider is to randomize by eye, with one eye randomised to TDLC and the other to trabeculoplasty. This design is possible with laser treatment, as the treatment of one eye has no or negligible impact on the other eye, and has the advantage of a smaller sample size, although statistical analysis has to take account of the clustered design. Long term follow up will be necessary at regular intervals to assess the long term outcome on visual fields and visual acuity. A trial of this nature could also address the level of IOP required to halt disease progression in African eyes.

Implications for service delivery

Multiple interventions and approaches are required to reduce glaucoma blindness, the “silent thief of sight”, in Africa. Important elements include increasing awareness using locally derived terms so that patients present earlier; improving primary eye care for earlier detection and referral; improving the education of glaucoma patients about their disease and their role in controlling it; improving the quality, capabilities and efficiency of services and the attitudes of staff; ensuring the availability of affordable eye drops and teaching patients or their carers how to instill them, and evaluating interventions appropriate to Africa to improve adherence to topical medication, acceptance of surgery and long term follow up. A priority is to establish a safe and effective of once-off treatment which is acceptable and affordable.

Data for the secondary outcomes of the trial are being collected and analysed and will be written up for publication.

APPENDICES

Appendix 1 Ethics approvals

Pilot paper ethics approval

LONDON SCHOOL OF HYGIENE
& TROPICAL MEDICINE

ETHICS COMMITTEE



APPROVAL FORM

Application number: 5744

Name of Principal Investigator Dr Abdull M Mahdi & Clare Gilbert

Department Infectious and Tropical Diseases

Head of Department Professor Simon Croft

Title: Bauchi adult glaucoma study: stage at presentation and uptake of treatment.

This application is approved by the Committee.

Chair of the Ethics Committee

Date8 July 2010.....

Approval is dependent on local ethical approval having been received.

Any subsequent changes to the application must be submitted to the Committee via an E2 amendment form.

MIG trial Ethics approval

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Observational / Interventions Research Ethics Committee

Mohammed Mahdi Abdull
Research Degree student
CR / ITD
LSHTM

17 July 2013

Dear Dr. Abdull,

Study Title: Adapted motivational interviewing to improve uptake of treatment in glaucoma patients in Bauchi State, Nigeria
LSHTM ethics ref: 6464

Thank you for your application of 17 June 2013 for the above research, which has now been considered by the Interventions Committee.

Confirmation of ethical opinion

On behalf of the Committee, I am pleased to confirm a favourable ethical opinion for the above research on the basis described in the application form, protocol and supporting documentation, subject to the conditions specified below.

Conditions of the favourable opinion

Approval is dependent on local ethical approval having been received, where relevant.

Please note the following recommendation from the committee: Section 2 talks about a Cochrane review of adherence to eye drops, which seems completely different from this study which is about 'adherence' to a recommended treatment. The issues around self-administering a daily treatment for long periods are fundamentally different in most ways from the issues involved in whether a patient comes in for surgery when recommended. This confused the reading as it seemed the incorrect literature upon which to base the intervention. Could you please comment on this observation?

Approved documents

The final list of documents reviewed and approved by the Committee is as follows:

Document	Version	Date
LSHTM ethics application	n/a	15 June 2013
Protocol	1.2	15 June 2013
Appendix A: Working Alliance Inventory: Participant form	1.0	June 2013
Appendix B: Working Alliance Inventory: Interviewer form		
Appendix D: Factors influencing acceptance of treatment for glaucoma in Bauchi - Information Sheet - to be translated into Hausa	1.0	June 2013
Appendix D: Factors influencing acceptance of treatment for glaucoma in Bauchi Consent form - to be translated into Hausa	1.0	June 2013
Appendix D: Follow up of participants who did not attend for surgery/ laser for glaucoma in Bauchi - Information Sheet - to be translated into Hausa	1.0	June 2013
Appendix D: Follow up of participants who did not attend for surgery/ laser for glaucoma in Bauchi Consent form - to be translated into Hausa	1.0	June 2013
Appendix E: Standard Information Sheet	1.0	June 2013
Appendix F: Main Data recording form	1.0	June 2013
Appendix G: Interview guide for those failing to attend for surgery/ laser	1.0	June 2013

After ethical review

Any subsequent changes to the application must be submitted to the Committee via an E2 amendment form. All studies are also required to notify the ethics committee of any serious adverse events which occur during the project via form E4. At the end of the study, please notify the committee via form E5.

Yours sincerely,



Professor John DH Porter
Chair

ethics@lshtm.ac.uk

<http://intra.lshtm.ac.uk/management/committees/ethics/>

MIG trial Ethics amendment

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Observational / Interventions Research Ethics Committee

Professor Clare Gilbert

LSHTM

4 September 2015

Dear Professor Gilbert,

Study Title: Adapted motivational interviewing to improve uptake of treatment in glaucoma patients in Bauchi State, Nigeria

LSHTM Ethics Ref: '6464-1'

Thank you for your letter responding to the Interventions Committee's request for further information on the above amendment to research and submitting revised documentation.

The further information has been considered on behalf of the Committee by the Chair.

Confirmation of ethical opinion

On behalf of the Committee, I am pleased to confirm a favourable ethical opinion for the above amendment to research on the basis described in the application form, protocol and supporting documentation as revised, subject to the conditions specified below.

Conditions of the favourable opinion

Approval is dependent on local ethical approval for the amendment having been received, where relevant.

Approved documents

The final list of documents reviewed and approved by the Committee is as follows:

Document Type	File Name	Date	Version
Other	Abdhill Bauchi protocol June 14 2013 FINAL	14/06/2013	1.2
Other	10166 Amendment feedback July 31 2015	31/07/2015	1
Covering Letter	10166 Amendment feedback July 31 2015	02/09/2015	1

After ethical review

The Chief Investigator (CI) or delegate is responsible for informing the ethics committee of any subsequent changes to the application. These must be submitted to the Committee for review using an Amendment form. Amendments must not be initiated before receipt of written favourable opinion from the committee.

The CI or delegate is also required to notify the ethics committee of any protocol violations and/or Suspected Unexpected Serious Adverse Reactions (SUSARs) which occur during the project by submitting a Serious Adverse Event form.

An annual report should be submitted to the committee using an Annual Report form on the anniversary of the approval of the study during the lifetime of the study.

At the end of the study, the CI or delegate must notify the committee using an End of Study form.

All aforementioned forms are available on the ethics online applications website and can only be submitted to the committee via the website at: <http://leo.lshtm.ac.uk>

Additional information is available at: www.lshtm.ac.uk/ethics

Yours sincerely,

A handwritten signature in black ink, appearing to read 'John Porter'.

Professor John DH Porter
Chair

ethics@lshtm.ac.uk
<http://www.lshtm.ac.uk/ethics/>

Improving health worldwide

MIG intervention development ethics Bauchi approval

ABUBAKAR TAFAWA BALEWA UNIVERSITY TEACHING HOSPITAL BAUCHI

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Chairman Governing Board Of Management
Maj.Gen. Suleman Barau Said mni (Rtd)



website :www.atbuth.org

Chief Medical Director
Dr.Mohammed Alkali BM,BCH,FWACP
(Gastroenterologist)

Service With Humility

ATBUTH/ADM/42/Vol. I
Ref No :

15/11/2011
Date:.....

Dr MOHAMMED M. ABDULL

**RE: DEVELOPMENT OF AN APPROPRIATE COUNSELLING TOOL
AND DELIVERY MODE FOR GLAUCOMA AWARENESS CREATION IN
A CLINIC IN BAUCHI STATE, NIGERIA.**

ATBUTH (REC) Assigned Number – 01/11/2011

Date of Approval: 15/11/2011

Address of Researcher; Department of Ophthalmology Abubakar Tafawa Balewa

University Teaching Hospital, Bauchi,

Email: mohammed.Abdul@ishtm.co.uk

GSM: +2348037420779

RE: NOTICE OF FULL APPROVAL

This is to inform you that the research in the submitted protocol, the consent forms and other vital documents have been reviewed and given full committee approval from 15th November, 2011. If there is any delay in starting the research please inform REC so that the date can be adjusted accordingly. Note that participant accrual or activity related to this research should not be conducted outside these days.

All informed consent forms used in the study must be carrying the assigned REC number and the duration of REC approval of the study. The national code for Health Research Ethics requires you to comply with all institutional guidelines, rules and regulations and with the tenants' of the code including ensuring that all adverse events are reported promptly to REC. No changes are permitted in the research without prior approval by REC except in circumstances outlined in the code. The REC reserves the right to conduct compliance visit to your research site without prior notice.

Dr. I. B. Peter Kio
Chairman Research & Ethics ATBUTH, Bauchi

MIG trial Bauchi approval

ABUBAKAR TAFAWA BALEWA UNIVERSITY TEACHING HOSPITAL BAUCHI

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Chairman Governing Board Of Management
Maj.Gen. Suleman Barau Said mni (Rtd)



website :www.atbuth.org
Chief Medical Director
Dr.Mohammed Alkali BM,BCH,FWACP
(Gastroenterologist)

ATBUTH/ADM/42/Vol. I

Ref No :

19/08/2013

Date:

Dr MOHAMMED M. ABDULL

**RE: ADAPTED MOTIVATIONAL INTERVIEWING TO IMPROVE
UPTAKE OF TREATMENT IN GLAUCOMA PATIENTS IN BAUCHI,
NIGERIA.**

ATBUTH (REC) Assigned Number – 02/21/08/2013

Date of Approval: 19/08/2013

Address of Researcher; Department of Ophthalmology AbubakarTafawaBalewa
University Teaching Hospital, Bauchi,


Email: mohammed.Abdul@ishtm.co.uk

GSM: +2348037420779

RE: NOTICE OF FULL APPROVAL

This is to inform you that the research in the submitted protocol, the consent forms and other vital documents have been reviewed and given full committee approval from 19th August, 2013. If there is any delay in starting the research please inform REC so that the date can be adjusted accordingly. Note that participant accrual or activity related to this research should not be conducted outside these days.

All informed consent forms used in the study must be carrying the assigned REC number and the duration of REC approval of the study. The national code for Health Research Ethics requires you to comply with all institutional guidelines, rules and regulations and with the tenants' of the code including ensuring that all adverse events are reported promptly to REC. No changes are permitted in the research without prior approval by REC except in circumstances outlined in the code. The REC reserves the right to conduct compliance visit to your research site without prior notice.


Dr. I. B. Peter Kio
Chairman Research & Ethics ATBUTH, Bauchi

Appendix 2: Patient information and consent documents

MIG trial information sheet for consent

LONDON
SCHOOL of
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MEDICINE



Factors influencing acceptance of treatment for glaucoma in Bauchi

INFORMATION SHEET

Introduction

My name is Fatima Muazu. I work in the eye clinic at the ATBU teaching hospital. I am working with eye doctors here, one of whom also works at the International Centre for Eye Health at the London School of Hygiene and Tropical Medicine.

Why have I been selected to take part in the study?

You have been approached to take part in this study because you have glaucoma, the eye condition this research project is focussing on.

Background

Glaucoma is quite a common eye condition in Nigerian adults. In glaucoma the nerve that carries information from the eye to the brain becomes damaged. This leads to gradual, painless loss of vision. Glaucoma usually affects both eyes. The condition cannot be prevented, but treatment can prevent people from losing more vision, and so prevent them from becoming blind. Once someone has become blind from glaucoma in one or both eyes treatment cannot restore the vision.

One of the problems with glaucoma is that in the early stages people do not know they have the condition: the eyes appear normal to others, and the loss of vision is at the edge of the vision which may not be noticeable. This means that people with glaucoma only become aware that they have the condition once quite a lot of damage has already taken place to the nerves at the back of the eye.

There are a range of treatment options for glaucoma, and in your case the eye doctor has recommended that you {have surgery} {be treated by laser, which is a special type of bright light} *(delete/read out as appropriate)*.

What is the purpose of the study?

In this study we are assessing factors help patients to decide whether to accept treatment for glaucoma.

What will happen if I take part in the study:

Everyone who takes part in the study will be given an information sheet about glaucoma and its treatment. You can take the sheet home and show it to your relatives, if you wish. If you cannot read we will be pleased to read the information out to you before you leave the clinic today.

About half the people in the study will also be interviewed for about 30 minutes by one of our two interviewers. Whether you are interviewed or not will be decided by chance. We will ask your permission to tape record the interview so that we don't have to rely on our memories of what you might say. Some of the interviews will be sent to for someone else to listen to, to make sure the interview has gone well. If your interview is selected to be sent to someone else, your name will not be mentioned, so this other person will not know it is you being interviewed. Whether you have the interview or not will not influence your care in any way, as you have already been given a date for treatment.

Right to refuse or withdraw from the trial

Your participation is entirely voluntary: if you decide not to take part this will not influence the type of treatment you receive for glaucoma. You also have the right to withdraw from the study at any stage and this will not affect your right to treatment in the eye clinic.

Inconvenience and discomfort

The only discomfort you may experience is some emotional stress during the interview. Should this happen we have trained counsellors nearby who can offer support, if needed.

Confidentiality

We will make every attempt to make sure that all the information you give us will be kept private, and will only be seen by members of the research team.

Financial arrangement

There is no financial arrangement for any participants except for refreshment and the refund of transport costs, if necessary.

Who to contact

The Abubakar Tafawa Balewa University Teaching Hospital (ATBUTH) hospital is responsible for protecting the public from harm from its employees.

If you have any queries please contact;

Dr Peter Kio,
Chairman Ethics Committee,
ATBU Teaching Hospital. Phone: 08057125985.

Dr Abdull Mohammad 08037420779
Ophthalmology Department
ATBUTH, Bauchi.

MIG trial consent form



Factors influencing acceptance of treatment for glaucoma in Bauchi CONSENT FORM

Investigator's name and contact details.

Dr Mohammed M Abdull
Ophthalmology Department
ATBU Teaching Hospital
Bauchi.
08037420779

International Centre for Eye Health
London School of Hygiene and Tropical
Medicine
Keppel Street, London WC1H7HT
Email: mohammed.abdull@lshtm.ac.uk

Hospital registration number

--	--	--	--	--	--	--

Study number

--	--	--

Marar lafiya ya chika yadda ya kamata.

	Yes	No
Na karanta takardar wannan aiki ko an fassara min ita da baki kuma na gane abin da akeso nayi idan na shiga binciken.	<input type="checkbox"/>	<input type="checkbox"/>
Tambayoyina akan wannan binciken sun sami amsa daga	<input type="checkbox"/>	<input type="checkbox"/>
Kuma na gane cewa zan iya fita daga wannan binciken a kowane lokacin da naga dama kuma ba sai na fadi dalili ba.	<input type="checkbox"/>	<input type="checkbox"/>
Na yarda a dauki tattaunawar mu da na'ura	<input type="checkbox"/>	<input type="checkbox"/>
Na yarda ayi amfani da abinda na fadi a cikin tattaunawar da akayi dani kuma za'a iya jingnashi dani.	<input type="checkbox"/>	<input type="checkbox"/>

Participants name:

Participants signature/thumb print

Signature of researcher:

Date:

Silent thief glaucoma education information leaflet (Hausa language)

(Hausa translation of the English version in the text above)



GLAUCOMA: MAI SACE GANI BATARE DA SANI BA

T - Menene glaucoma?

A – Glaucoma shine hawan jinin ido wadda ke lalata jijiyar dake kai sa’ko zuwa ‘kwa’kwalwa domin gani. Mutane da yawa basu san da wannan ciwon ba.

T – Me yake jawo ciwon glaucoma?

A – Mafi aksari ba’a san meke kawo ciwon ba, amma yafi kama:

- Mutane masu shekaru 40 zuwa sama.
- Masu ‘yan uwa da suke da ciwon.
- Masu amfani da gilashin hangen nesa.
- Masu amfani da magungunan steroids.
- Masu ciwon hawan jinni da ciwon suga.
- Wanda ya buga idonsa.

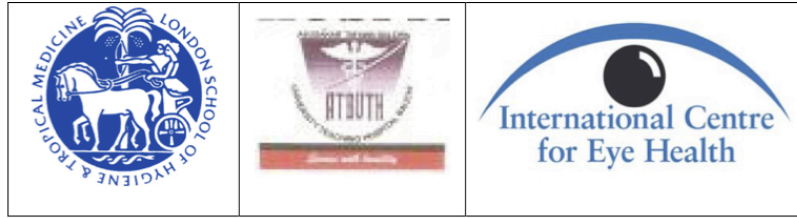
Ba’kin ‘kuda,’Bacin rai, Fushi, Sanyi, haya’ki ‘Kura, Iska, Yawan kuka da Aljannu basa kawo ciwon hawan jinin ido. Ba’a samun ciwon kuma daga zamantakewa.

T – Ta yaya ciwon glaucoma yake jawo makanta?

A - A cikin ido akwai ruwa wanda yake tafiyar da lafiyar ido. Wani lokaci ruwan yakan hau har ya jawo illa ga jijiyar idon. Wannan illar ce ke jawo makanta. . Hawan jinin ido yana ‘daya daga cikin cututtukan ido dake lalata ido har abada.

T – Wanene zai iya kamuwa da ciwon glaucoma?

A – Kowa zai iya kamuwa, yaro da bubba. Amma yafi faruwa da mutane masu shekaru sama da 35.



T – Taya ake gane ciwon?

- Farkon fara ciwon mutum bazai san yana dashi ba.
- Ido baya ciwo yawancin lokuta.
- Ganinka na gefe-gefen yana ta’bar’barewa ko ya tsuke
- Baza kaga abinda ke gefenka ba sai abinda ke gabanka kawai idan ciwon yayi nisa
- Zaka iya ganin hazo hazo a koyaushe tare da ganinka.
- Zaka iya ganin haske yayi jau

T - Za’a iya magance glaucoma (Hawan jinin ido)?

A - Za’a iya magance hawan jinin ido don a hana ta’bar’barewan ganin, amma fa ka sani ganin da aka rasa an rasa shi kenan har abada.

T – Za’a iya samun warakan ciwon nan ta maganin gargajiya?

A - Magungunan ido na gargajiya da makamantansu basa tsaida ciwon glaucoma, saidai ma su sa jinkiri a neman magani, wannan jinkirin kuma zai iya jawo makanta. Yawancin magungunan gargajiya da ake amfani dasu basu da adadi. Ana amfani da magani d’aya ma cututtuka dayawa. Masu bada maganin gargajiya basu cika zama wuri d’aya ba, sabida haka ko kana da kuka bazaka same su ba. Bayan haka kuma basu da na’uran gwajin ido. Saboda wayenan dalilan, bamu bada shawaran ampani da magungunan gargajiya ko wani iri a ciwon ido.

T – Hanyoyin tsaida ciwon glaucoma

A –

- Akwai magunguna daban daban (na sha dana d’igawa) da ake ampani dasu ana tsaida ciwon glaucoma. Muddin aka fara ‘diga magani ba’a bari ba tareda sanin likita ba.
- Akwai kuma aikin tiyata na tsaida ciwon glaucoma da akeyi a ido. Mutane da yawa na tsoron aikin tiyatan glaucoma, Amman baa bin tsoro bane don ana samun nasaran tsaida ciwon kuma anyi ma mutane dayawa kuma sunji dad’in aikin.
- Aikin tiyata yafi arha akan sayan magani saboda shi maganin d’igawa har iya rayuwa ne. Aikin babu zafi kuma baya wuce mintoci 20 kuma ba sai kayi jinya a asibiti ba.



- Akwai kuma wani hanyar tsaida ciwon wanda ake kira LASER. Ana amfani da haske mai tsanini kuma shima ana samun nasara. Shima basai anyi jiya a asibiti ba.

Karin bayani akan tsaida ciwon glaucoma

- Maganin glaucoma ba irin maganin da zakayi amfani dashi yanzu kaga amfanin shi yanzu yanzu bane. Sai ana amfani dashi na tsawon lokaci kafin ya tsaida ciwon.
- Bai kamata ka tsaida amfani da maganin ka don ka samu sau'ki ba ko kuma kayi amfani da maganin ka idan ido ba lafiya ba.
- Ana bukatan ka cigaba da yin amfani da maganinka koda a naka ganin ganinka baiyya gyaruwa.
- Idan ka bar yin amfani da maganinka, zaka iya rasa d'an ganin daya rage ma.
- Ka samu wad'ansu hanyoyin tunatarwa dazasu taimaka ma wajen amfani dasu akan lokaci. (Tuntu'bi mara lafiya don a samu)
- Idan kana da matsala da maganinka, kada ka bar amfani dashi. Ka fad'a ma likitan ka ko zai iya chanja maka.
- Ka tuna, koda idonka baya gani, kada ka bar amfani da maganin ka. Barin sa magani zai iya jawo matasala mai girma, kamar rad'ad'i mai tsanani har kaji kamar a cire idon.

T – Menene zai faru idan ba'a magance ciwon glaucoma ba?

A – Glaucoman da aka kyaleta zatayi barna a ganin maishi har ya kaiga makantan da babu maganin sa.

T – Ta yaya za'a iya kauce wa makanta daga glaucoma?

A –

- Idan aka gano hawan jinin ido da wuri kafin idon ya lalace, kuma aka tsaida shi, to zai iya kare ka daga makanta na har abada.
- Bin umurnin masu aikin asibiti wanda ya shafi magance ciwon da kuma dawowa asibiti don duba lafiyan idon.

Amfanin gano ciwon gano/ tare ciwon glaucoma da wuri shine yanci daga samun makantan da bashi da waraka.



T – Me zakayi idan an sameka da hawan jinin ido?

A -

- Kada ka shagala da zuwa asibiti akan kari don ganinka ya ‘karu.
- Kada a tsallake lokutan shan/ diga magani
- Kada aji tsoron aikin ityata idan har likita yaga ya dace ayi.

Q – Zan cigaba da amfani da magungunan glaucoma ne bayan anyi aikin tiyata?

A – Za’a cigaba da amfani da magunguna har sai idon ya warke. Wasu lokuta akan cigaba da amfani da magungunan glaucoma bayan aikin tiyatan in har likita yaga hakan yafi dacewa.

A KULA

- Ana gadon glaucoma kuma gano ciwon da wuri a asibiti zai kareka daga makanta. Yana da mahimmanci gayyata da kuma ‘karfafa iyalanka da danginka su zo bincinken glaucoma.
- Kada ka shagala da zuwa asibiti akan kari don ganinka ya ‘karu.
- Kada ka bari matsala da ma’aikatan asibiti ya hana ka zuwa asibiti. Idan ka samu matsala da ma’aikatan asibiti ka kai kukan ka zuwa ga babban jami’in gurin.
- Kada ka bar wani ciwo ya hana ka amfani da maganinka da kuma dawowa asibiti.
- Kula da ciwon idonka zai kawo kar’buwa wajen ‘yan uwanka da cigaba da hurd’an rayuwa gaba d’aya.
- ‘Yan uwa da abokan arziki baza su gujeka ba don baka zama musu wani nauyi ko jidali ba idan ka nemi maganin glaucoma.
- A karshe, kada bar glaucoma ya kashe maka zuciya.

Appendix 4: Data collection forms

Main MIG data form



Randomised Controlled Trial of Modified Motivational Interviewing for Acceptance and Adherence to Treatment in Glaucoma Patients in Bauchi

ELIGIBILITY FORM

To be completed by ophthalmologist

1	1 Name of patient	<hr/>											
2	2 Hospital number	<table border="1"><tr><td></td><td></td><td></td><td></td><td></td><td></td></tr></table>											
3	3 Today's date	<table border="1"><tr><td></td><td></td></tr></table> Day			<table border="1"><tr><td></td><td></td></tr></table> Month			<table border="1"><tr><td>2</td><td>0</td><td>1</td><td></td></tr></table> Year		2	0	1	
2	0	1											
4	4 Age	<table border="1"><tr><td></td><td></td></tr></table> Years											
5	5 Gender	<table border="1"><tr><td>1</td><td>Male</td></tr><tr><td>2</td><td>Female</td></tr></table>				1	Male	2	Female				
1	Male												
2	Female												
6	6 Fulfills eligibility criteria:												
		Yes	No										
	6 Has primary open angle glaucoma	<table border="1"><tr><td>1</td></tr></table>	1	<table border="1"><tr><td>2</td></tr></table>			2						
1													
2													
	7 Needs surgery or laser to preserve vision in one or both eyes	<table border="1"><tr><td>1</td></tr></table>	1	<table border="1"><tr><td>2</td></tr></table>			2						
1													
2													
	8 Not previously had glaucoma surgery or laser in either eye	<table border="1"><tr><td>1</td></tr></table>	1	<table border="1"><tr><td>2</td></tr></table>			2						
1													
2													
	9 Not referred specifically for treatment	<table border="1"><tr><td>1</td></tr></table>	1	<table border="1"><tr><td>2</td></tr></table>			2						
1													
2													
	# 17 years of age or older	<table border="1"><tr><td>1</td></tr></table>	1	<table border="1"><tr><td>2</td></tr></table>			2						
1													
2													
	# Lives within 200 kms of ABUTH	<table border="1"><tr><td>1</td></tr></table>	1	<table border="1"><tr><td>2</td></tr></table>			2						
1													
2													
	# No other ocular pathology (except cataract)	<table border="1"><tr><td>1</td></tr></table>	1	<table border="1"><tr><td>2</td></tr></table>			2						
1													
2													
	# Speaks Hausa or English	<table border="1"><tr><td>1</td></tr></table>	1	<table border="1"><tr><td>2</td></tr></table>			2						
1													
2													
	If "Yes" to ALL the above the patient is eligible												
7	7 Patient is eligible for the study	<table border="1"><tr><td>1</td><td>Yes</td></tr><tr><td>2</td><td>No</td></tr></table>				1	Yes	2	No				
1	Yes												
2	No												

If yes, take to Project Manager for recruitment

RECRUITMENT FORM
To be completed by Project Manager

8 1 Information sheet read out,
or given to read

1	Yes
2	No

9 2 Patient agrees to participate

1	Yes
2	No

If yes, PATIENT IS NOW RECRUITED. GIVE STUDY NUMBER

If no, go to Q12

10 3 Allocate a unique study number:

--	--	--

11 Date recruited

--	--

Day

--	--

Month

2	0	1	
---	---	---	--

Year

Complete the following for those who refuse to participate:

12 4 If does not agree to participate, why?

1	Does not have time
2	Needs to discuss the decision with family
3	Anxious/concerned about the intervention (MIG)
4	Wants to get another opinion
5	Cost: cannot afford the follow up visits
6	Other _____

Contact details for those who agree to take part:

13 5 Detailed address for tracing (include landmarks):

14 6 Name of household head in neighbouring house

15 7 Telephone number:

1

16 8 Whose number is this?

Name: _____ Relationship/role: _____

17 9 Telephone number:

2

18 # Whose number is this?

Name: _____ Relationship/role: _____

1. Enter ALL these details into the database

2. Enter study number on EVERY PAGE of EVERY form

3. Now compete Sections 1 and 2 in the MAIN Form

ALWAYS KEEP LOCKED IN THE PROJECT OFFICE

SECTION 1 - SUMMARY (To be completed by project manager)

19	Study Number	<div style="border: 1px solid black; width: 40px; height: 20px; display: inline-block;"></div> <div style="border: 1px solid black; width: 40px; height: 20px; display: inline-block;"></div> <div style="border: 1px solid black; width: 40px; height: 20px; display: inline-block;"></div>	
20	Name of patient		
21	Hospital number	<div style="border: 1px solid black; width: 30px; height: 20px; display: inline-block;"></div> <div style="border: 1px solid black; width: 30px; height: 20px; display: inline-block;"></div> <div style="border: 1px solid black; width: 30px; height: 20px; display: inline-block;"></div> <div style="border: 1px solid black; width: 30px; height: 20px; display: inline-block;"></div> <div style="border: 1px solid black; width: 30px; height: 20px; display: inline-block;"></div> <div style="border: 1px solid black; width: 30px; height: 20px; display: inline-block;"></div>	
22	Date recruited	<div style="border: 1px solid black; width: 30px; height: 20px; display: inline-block;"></div> <div style="border: 1px solid black; width: 30px; height: 20px; display: inline-block;"></div> <div style="border: 1px solid black; width: 30px; height: 20px; display: inline-block;"></div> <div style="border: 1px solid black; width: 30px; height: 20px; display: inline-block;"></div> <div style="border: 1px solid black; width: 30px; height: 20px; display: inline-block;"></div> <div style="border: 1px solid black; width: 30px; height: 20px; display: inline-block;"></div>	<div style="border: 1px solid black; width: 30px; height: 20px; display: inline-block;"></div> <div style="border: 1px solid black; width: 30px; height: 20px; display: inline-block;"></div> <div style="border: 1px solid black; width: 30px; height: 20px; display: inline-block;"></div> <div style="border: 1px solid black; width: 30px; height: 20px; display: inline-block;"></div>
		<i>Day</i>	<i>Month</i>
			<i>Year</i>
23	Age	<div style="border: 1px solid black; width: 30px; height: 20px; display: inline-block;"></div> <div style="border: 1px solid black; width: 30px; height: 20px; display: inline-block;"></div>	years
24	Sex	<div style="border: 1px solid black; width: 30px; height: 20px; display: inline-block;"></div> <div style="border: 1px solid black; width: 30px; height: 20px; display: inline-block;"></div>	<div style="border: 1px solid black; width: 30px; height: 20px; display: inline-block;"></div> Male <div style="border: 1px solid black; width: 30px; height: 20px; display: inline-block;"></div> Female
25	Study eye	<div style="border: 1px solid black; width: 30px; height: 20px; display: inline-block;"></div> <div style="border: 1px solid black; width: 30px; height: 20px; display: inline-block;"></div>	<div style="border: 1px solid black; width: 30px; height: 20px; display: inline-block;"></div> Right <div style="border: 1px solid black; width: 30px; height: 20px; display: inline-block;"></div> Left
26	Randomization sequence no. for MIG	<div style="border: 1px solid black; width: 40px; height: 20px; display: inline-block;"></div> <div style="border: 1px solid black; width: 40px; height: 20px; display: inline-block;"></div> <div style="border: 1px solid black; width: 40px; height: 20px; display: inline-block;"></div>	
27	Surgery date	<div style="border: 1px solid black; width: 30px; height: 20px; display: inline-block;"></div> <div style="border: 1px solid black; width: 30px; height: 20px; display: inline-block;"></div> <div style="border: 1px solid black; width: 30px; height: 20px; display: inline-block;"></div> <div style="border: 1px solid black; width: 30px; height: 20px; display: inline-block;"></div> <div style="border: 1px solid black; width: 30px; height: 20px; display: inline-block;"></div> <div style="border: 1px solid black; width: 30px; height: 20px; display: inline-block;"></div>	<div style="border: 1px solid black; width: 30px; height: 20px; display: inline-block;"></div> <div style="border: 1px solid black; width: 30px; height: 20px; display: inline-block;"></div> <div style="border: 1px solid black; width: 30px; height: 20px; display: inline-block;"></div> <div style="border: 1px solid black; width: 30px; height: 20px; display: inline-block;"></div>
		<i>Day</i>	<i>Month</i>
			<i>Year</i>
28	Tracing initiation date:	<div style="border: 1px solid black; width: 30px; height: 20px; display: inline-block;"></div> <div style="border: 1px solid black; width: 30px; height: 20px; display: inline-block;"></div> <div style="border: 1px solid black; width: 30px; height: 20px; display: inline-block;"></div> <div style="border: 1px solid black; width: 30px; height: 20px; display: inline-block;"></div> <div style="border: 1px solid black; width: 30px; height: 20px; display: inline-block;"></div> <div style="border: 1px solid black; width: 30px; height: 20px; display: inline-block;"></div>	<div style="border: 1px solid black; width: 30px; height: 20px; display: inline-block;"></div> <div style="border: 1px solid black; width: 30px; height: 20px; display: inline-block;"></div> <div style="border: 1px solid black; width: 30px; height: 20px; display: inline-block;"></div> <div style="border: 1px solid black; width: 30px; height: 20px; display: inline-block;"></div>
	2 months + 1 day after surgery date	<i>Day</i>	<i>Month</i>
			<i>Year</i>
29	REVISED DATES ONLY <i>Revised surgery date</i> <div style="display: flex; justify-content: space-around; margin-top: 5px;"> <div style="border: 1px solid black; width: 30px; height: 20px;"></div> <div style="border: 1px solid black; width: 30px; height: 20px;"></div> <div style="border: 1px solid black; width: 30px; height: 20px;"></div> <div style="border: 1px solid black; width: 30px; height: 20px;"></div> <div style="border: 1px solid black; width: 30px; height: 20px;"></div> <div style="border: 1px solid black; width: 30px; height: 20px;"></div> </div>		<div style="border: 1px solid black; width: 30px; height: 20px; display: inline-block;"></div>
		<i>Day</i>	<i>Month</i>
			<i>Year</i>
30	<i>Revised tracing initiation date</i> 2 months + 1 days after the surgery date <div style="display: flex; justify-content: space-around; margin-top: 5px;"> <div style="border: 1px solid black; width: 30px; height: 20px;"></div> <div style="border: 1px solid black; width: 30px; height: 20px;"></div> <div style="border: 1px solid black; width: 30px; height: 20px;"></div> <div style="border: 1px solid black; width: 30px; height: 20px;"></div> <div style="border: 1px solid black; width: 30px; height: 20px;"></div> <div style="border: 1px solid black; width: 30px; height: 20px;"></div> </div>		<div style="border: 1px solid black; width: 30px; height: 20px; display: inline-block;"></div>
		<i>Day</i>	<i>Month</i>
			<i>Year</i>
31	Date participant had surgery or laser:	<div style="border: 1px solid black; width: 30px; height: 20px; display: inline-block;"></div> <div style="border: 1px solid black; width: 30px; height: 20px; display: inline-block;"></div> <div style="border: 1px solid black; width: 30px; height: 20px; display: inline-block;"></div> <div style="border: 1px solid black; width: 30px; height: 20px; display: inline-block;"></div> <div style="border: 1px solid black; width: 30px; height: 20px; display: inline-block;"></div> <div style="border: 1px solid black; width: 30px; height: 20px; display: inline-block;"></div>	<div style="border: 1px solid black; width: 30px; height: 20px; display: inline-block;"></div> <div style="border: 1px solid black; width: 30px; height: 20px; display: inline-block;"></div> <div style="border: 1px solid black; width: 30px; height: 20px; display: inline-block;"></div> <div style="border: 1px solid black; width: 30px; height: 20px; display: inline-block;"></div>
		<i>Day</i>	<i>Month</i>
			<i>Year</i>
32	Attendance for surgery or laser:	<div style="border: 1px solid black; width: 30px; height: 20px; display: inline-block;"></div> 1 Yes, on surgery date (OR revised date) <div style="border: 1px solid black; width: 30px; height: 20px; display: inline-block;"></div> 2 Yes, within 2 months of surgery date (OR revised date) <div style="border: 1px solid black; width: 30px; height: 20px; display: inline-block;"></div> 3 Yes, but more than 2 months after the surgery date (OR revised date) <div style="border: 1px solid black; width: 30px; height: 20px; display: inline-block;"></div> 4 No, did not attend for any surgery (this <u>must</u> be confirmed) <div style="border: 1px solid black; width: 30px; height: 20px; display: inline-block;"></div> 5 Not known, could not be contacted	
33	If yes, which procedure did they have:	<div style="border: 1px solid black; width: 30px; height: 20px; display: inline-block;"></div> 1 Trabeculectomy alone <div style="border: 1px solid black; width: 30px; height: 20px; display: inline-block;"></div> 2 Trabeculectomy + SICS/ECCE <div style="border: 1px solid black; width: 30px; height: 20px; display: inline-block;"></div> 3 Laser trabeculoplasty <div style="border: 1px solid black; width: 30px; height: 20px; display: inline-block;"></div> 4 Laser cycloablation <div style="border: 1px solid black; width: 30px; height: 20px; display: inline-block;"></div> 5 Either trabeculectomy or laser	

SECTION 2 - DEMOGRAPHIC DETAILS (To be completed by Project Manager)

- 34** Ethnic group
- | | |
|---|--------|
| 1 | Hausa |
| 2 | Fulani |
| 3 | Igbo |
| 4 | Yoruba |
| 5 | Other |
- 35** Education
- | | |
|---|--------------------------------|
| 0 | None |
| 1 | Adult education/Primary school |
| 2 | Secondary school |
| 3 | Graduate/Diploma |
| 4 | Post graduate |
| 5 | Informal schooling |
- 36** Can use computer
- | | |
|---|-----|
| 1 | Yes |
| 2 | No |
- 37** Distance: Home to ATBUTH
- | | | | |
|--|--|--|------------|
| | | | Kilometers |
|--|--|--|------------|
- 38** Participant is household head?
- | | |
|---|-----|
| 1 | Yes |
| 2 | No |
- 39** Occupation of participant
- | | |
|---|----------------------------|
| 1 | Housework/Unwaged |
| 2 | Professional (nurse, etc) |
| 3 | Worker/Labourer |
| 4 | Trader |
| 5 | Retired |
| 6 | Student |
| 7 | Other |
- 40** Occupation of household head
- | | |
|---|----------------------------|
| 1 | Housework/Unwaged |
| 2 | Professional (nurse, etc) |
| 3 | Worker/Labourer |
| 4 | Trader |
| 5 | Retired |
| 6 | Student |
| 7 | Other |
- 41** Any communication problems
- | | |
|---|----------------------|
| 1 | None |
| 2 | Hearing impaired |
| 3 | Speech impaired |
| 4 | Cognitively impaired |

SECTION 3 - CLINICAL DETAILS (To be completed by Ophthalmologist)

42	Mode of presentation	<input type="checkbox"/> 1 Symptomatic <input type="checkbox"/> 2 Abnormality detected by nurse or optometrist at ABUTH <input type="checkbox"/> 3 Diagnosed elsewhere/Referred but no treatment recommended	
43	Completely new case	<input type="checkbox"/> 1 Yes, completely new patient <input type="checkbox"/> 2 No, already diagnosed elsewhere	Go to 46 Go to 45
44	If already diagnosed, where	<input type="checkbox"/> 1 Government Hospital <input type="checkbox"/> 2 NGO Hospital <input type="checkbox"/> 3 Private Hospital <input type="checkbox"/> 4 Optometry Clinic <input type="checkbox"/> 5 Traditional Healer <input type="checkbox"/> 6 Other	
45	For previously diagnosed patients: How long ago was the diagnosis?	<input type="text"/> <input type="text"/> years	
46	What treatment is the patient currently taking	<input type="checkbox"/> 1 None <input type="checkbox"/> 2 Eye drops alone <input type="checkbox"/> 3 Tablets alone e.g. Diamox <input type="checkbox"/> 4 Eye drops and tablet <input type="checkbox"/> 5 Other e.g. traditional <input type="checkbox"/> 6 Does not know/remember	
47	If the patient uses drops, to which eye	<input type="checkbox"/> 1 Right <input type="checkbox"/> 2 Left <input type="checkbox"/> 3 Both	
48	For all participants: Presenting visual acuity (Logmar)	Right eye <input type="text"/> . <input type="text"/>	Left eye <input type="text"/> . <input type="text"/>
50	Tested with spectacles	<input type="checkbox"/> 1 Yes <input type="checkbox"/> 2 No	
51	RAPD	<input type="checkbox"/> 1 Yes <input type="checkbox"/> 2 No <input type="checkbox"/> 3 Cannot test	
53	IOP (applanation tonometry Reading 1)	<input type="text"/> <input type="text"/> mmHg 99=cannot assess	
55	IOP (applanation tonometry Reading 2)	<input type="text"/> <input type="text"/> mmHg 99=cannot assess	
57	VCDR	<input type="text"/> . <input type="text"/> 9.9=cannot assess	
59	Disc photo taken	Right eye <input type="checkbox"/> 1 Yes <input type="checkbox"/> 2 No, no view of fundus <input type="checkbox"/> 3 No, patient not cooperative <input type="checkbox"/> 9 No, equipment problem	
61	Perimetry (Threshold testing) done (Enter and save patients number on file)	<input type="checkbox"/> 1 Yes <input type="checkbox"/> 2 No, no fixation <input type="checkbox"/> 3 No, patient not cooperative <input type="checkbox"/> 9 No, equipment problem	
49		Codes if <3/60 1.5 2/60 2.0 CFs at 50 cms 3.0 HM 4.0 PL 5.0 NPL 9.9 Cannot test	
52		<input type="checkbox"/> 1 Yes <input type="checkbox"/> 2 No <input type="checkbox"/> 3 Cannot test	
54		<input type="text"/> <input type="text"/> mmHg 99=cannot assess	
56		<input type="text"/> <input type="text"/> mmHg 99=cannot assess	
58		<input type="text"/> . <input type="text"/> 9.9=cannot assess	
60		Left eye <input type="checkbox"/> 1 Yes <input type="checkbox"/> 2 No, no view of fundus <input type="checkbox"/> 3 No, patient not cooperative <input type="checkbox"/> 9 No, equipment problem	
62		<input type="checkbox"/> 1 Yes <input type="checkbox"/> 2 No, no fixation <input type="checkbox"/> 3 No, patient not cooperative <input type="checkbox"/> 9 No, equipment problem	

Print out perimetry and extract MD values for each eye and fill below

- 63 MD Right eye
- dB
- 65 MDT done 1 Yes
(Enter and save patients number on file) 2 No, no fixation
3 No, patient not cooperative
9 No, equipment problem
3
- 67 Stage of POAG glaucoma 1 None Full field
2 Early Any other confirmed loss
3 Moderate Central field: 10 - 20°
4 Advanced Central field: <10° field
5 End stage No central fixation; VA<CF
- 69 Which eye is the STUDY eye?
i.e. eye in most urgent need of treatment 1 Right eye
2 Left eye
- 70 Treatment recommended
by physician for STUDY eye: 1 Trabeculectomy alone
2 Trabeculectomy + SICS/ECCE
3 Laser trabeculoplasty
4 Laser cycloablation
5 Either trabeculectomy or laser
- 71 Anti-metabolite to be used 1 No
2 5FU
3 Mitomycin C
- 72 Date given to attend for surgery
within 4 weeks of recruitment Day Month Year
- 73 Completed by (Initials)

ONLY COMPLETE IF A NEW DATE FOR SURGERY IS GIVEN

- 74 Date given to attend for surgery
within 4 weeks of recruitment Day Month Year
- 75 Reasons for a new surgery date: 1 Hospital cancelled the first date
2 Participant requested a change of date
3 Other _____

RANDOMIZATION

- 76 BROWN envelop sequence number
[Discard envelop in sealed container]

--	--	--

* Complete surgery register
* Enter date on summary sheet
on page 3

* Complete surgery register
* Enter date on summary sheet
on page 3

SECTION 4 - CLINICAL DETAILS AT FOLLOW UP (Ophthalmologist)

6 month follow up after randomisation

77 Date of follow up visit
Day Month Year

78 IOP mmHg 99=cannot assess

80 Method of measurement 1 Goldman
 2 Perkins
 3 Airpuff

79 mmHg 99=cannot assess

81 1 Goldman
 2 Perkins
 3 Airpuff

82 Presenting visual acuity .

83 .

84 Tested with spectacles: 1 Yes
 2 No

86 Number of visits since randomisation

Codes if <3/60

1.5 2/60
2.0 CFs at 50 cms
3.0 HM
4.0 PL
5.0 NPL
9.9 Cannot test

FOR THOSE NOT UNDERGOING SURGERY OR LASER

87 Reason

Participant reasons

1 Forgot
 2 Busy
 3 Family issues
 4 No money
 5 No need
 6 Other health/mobility problems (self)
 7 Tired
 8 Fear of surgery
 9 Preferred traditional remedy
 10 Climate problems
 11 Died
 12 Other

Provider reasons

1 No surgeon
 2 No electricity
 3 No consumables
 4 Civil unrest
 5 Other

88 Medication adherence score (Morisky adherence score)

Questions	Yes or No	Score
1. Do you sometimes forget to take your medicine?		Y=1, N=0
2. People sometimes miss taking their medicines for reasons other than forgetting. Thinking over the past 2 weeks, were there days when you did not take your medicine?		Y=1, N=0
3. Have you ever cut back or stopped taking your medicine without telling your doctor because you felt worse when you took it?		Y=1, N=0
4. When you travel or leave home, do you sometimes forget to bring along your medicines?		Y=1, N=0
5. Did you take all your medicines yesterday?		Y=0, N=1
6. When you feel like your symptoms are under control, do you sometimes stop taking your medicines?		Y=1, N=0
7. Taking medicine every day is a real inconvenience for some people. Do you ever feel hassled about sticking to your treatment plan?		Y=1, N=0
8. How often do you have difficulty remembering to take all your medicine?	A. Never/rarely B. Once in a while C. Sometimes D. Usually E. All the time	Choose one: A-E A=0, B-E=1
Total score =		

12 month follow up after randomisation

98 Medication adherence score (Morisky adherence score)

Total score =

Working alliance Inventory (WAI) forms, interviewer and patient



Randomised Controlled Trial of Adapted Motivational Interviewing for Acceptance and Adherence to Treatment in Glaucoma Patients in Bauchi

Working Alliance Inventory- Interviewer

Study number

Hospital registration number

Interviewer ID

Date Day Month Year

Measurement Point (circle one): 1st MIG 2nd MIG

On the following page there are sentences that describe some of the different ways you might think or feel about your patient.

As you read the sentences mentally insert the name of your patient in place of _____ in the text. Below each statement there is a seven point scale:

1	2	3	4	5	6	7
Never	Rarely	Occasionally	Sometimes	Often	Very Often	Always

If the statement describes the way you *always* feel (or think) circle the number 7; If it never applies to you, circle the number 1. Use the numbers in between to describe the variations between these extremes.

Work quickly, your first impressions are the ones we would like to see.

PLEASE DON'T FORGET TO RESPOND TO EVERY ITEM.

Thank You

- 1 _____ and I agree about the steps to be taken to improve his situation.

1	2	3	4	5	6	7
Never	Rarely	Occasionally	Sometimes	Often	Very Often	Always

- 2 My client and I both feel confident about the usefulness of our current activity in counseling.

1	2	3	4	5	6	7
Never	Rarely	Occasionally	Sometimes	Often	Very Often	Always

- 3 I believe _____ likes me.

1	2	3	4	5	6	7
Never	Rarely	Occasionally	Sometimes	Often	Very Often	Always

- 4 _____ have doubts about what we are trying to accomplish in counseling.

1	2	3	4	5	6	7
Never	Rarely	Occasionally	Sometimes	Often	Very Often	Always

- 5 I am confident in my ability to help _____.

1	2	3	4	5	6	7
Never	Rarely	Occasionally	Sometimes	Often	Very Often	Always

- 6 We are working towards mutually agreed upon goals.

1	2	3	4	5	6	7
Never	Rarely	Occasionally	Sometimes	Often	Very Often	Always

- 7 I appreciate _____ as a person.

1	2	3	4	5	6	7
Never	Rarely	Occasionally	Sometimes	Often	Very Often	Always

- 8 We agree on what is important for _____ to work on.

1	2	3	4	5	6	7
Never	Rarely	Occasionally	Sometimes	Often	Very Often	Always

- 9 _____ and I have built a mutual trust.

1	2	3	4	5	6	7
Never	Rarely	Occasionally	Sometimes	Often	Very Often	Always

- 10 _____ and I have different ideas on what his real problems are.

1	2	3	4	5	6	7
Never	Rarely	Occasionally	Sometimes	Often	Very Often	Always

- 11 We have established a good understanding between us of the kind of changes that would be good for _____.

1	2	3	4	5	6	7
Never	Rarely	Occasionally	Sometimes	Often	Very Often	Always

- 12 _____ believes the way we are working with her problem is correct.

1	2	3	4	5	6	7
Never	Rarely	Occasionally	Sometimes	Often	Very Often	Always



**Randomised Controlled Trial of Adapted Motivational Interviewing for
Acceptance and Adherence to Treatment in Glaucoma Patients in Bauchi**

Working Alliance Inventory- Patient

Name _____

Study number

Hospital registration number

Interviewer ID

Date

 /

 /

Day Month Year

Measurement Point (circle one):

 1st MIG

 2nd MIG

Indication for second interview

1	Could not stay for the MIG on day of recruitment
2	Interview not completed as participant had to leave
3	Frequent interruptions from escort
Other	_____

Duration of interview

 Minutes

Language of interview

1	Hausa
2	English

On the following page there are sentences that describe some of the different ways you might think or feel about your interviewer.

As you read the sentences mentally insert the name of your interviewer in place of _____ in the text. Below each statement there is a seven point scale:

1	2	3	4	5	6	7
Never	Rarely	Occasionally	Sometimes	Often	Very Often	Always

If the statement describes the way you *always* feel (or think) circle the number 7; If it never applies to you, circle the number 1. Use the numbers in between to describe the variations between these extremes.

Work quickly, your first impressions are the ones we would like to see.

PLEASE DON'T FORGET TO RESPOND TO EVERY ITEM.

Thank You

1 _____ and I agree about the things I will need to do in counseling to help improve my situation

1	2	3	4	5	6	7
Never	Rarely	Occasionally	Sometimes	Often	Very Often	Always

2 What I am doing in counseling gives me new ways of looking at my problem.

1	2	3	4	5	6	7
Never	Rarely	Occasionally	Sometimes	Often	Very Often	Always

- 3 I believe _____ likes me.

1	2	3	4	5	6	7
Never	Rarely	Occasionally	Sometimes	Often	Very Often	Always

- 4 _____ does not understand what I am trying to accomplish in counseling.

1	2	3	4	5	6	7
Never	Rarely	Occasionally	Sometimes	Often	Very Often	Always

- 5 I am confident in _____'s ability to help me.

1	2	3	4	5	6	7
Never	Rarely	Occasionally	Sometimes	Often	Very Often	Always

- 6 _____ and I are working towards mutually agreed upon goals.

1	2	3	4	5	6	7
Never	Rarely	Occasionally	Sometimes	Often	Very Often	Always

- 7 I feel that _____ appreciates me.

1	2	3	4	5	6	7
Never	Rarely	Occasionally	Sometimes	Often	Very Often	Always

- 8 We agree on what is important for me to work on.

1	2	3	4	5	6	7
Never	Rarely	Occasionally	Sometimes	Often	Very Often	Always

- 9 _____ and I trust one another.

1	2	3	4	5	6	7
Never	Rarely	Occasionally	Sometimes	Often	Very Often	Always

- 10 _____ and I have different ideas on what my problems are.

1	2	3	4	5	6	7
Never	Rarely	Occasionally	Sometimes	Often	Very Often	Always

- 11 We have established a good understanding of the kind of changes that would be good for me.

1	2	3	4	5	6	7
Never	Rarely	Occasionally	Sometimes	Often	Very Often	Always

- 12 I believe the way we are working with my problem is correct.

1	2	3	4	5	6	7
Never	Rarely	Occasionally	Sometimes	Often	Very Often	Always

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5. Kyari F, Abdull MM, Klage, D. Ogunro, A (2012) Medical treatment of open-angle glaucoma. Community Eye Health 2012; 25 (79-80):77-79.

Name: Fatima Kyari

Sign:



Date:

14 Dec 2016


To Abdull

I agree that our work indicated below can be included in its/their published format in your thesis titled "Adapted motivational interviewing to improve uptake of treatment in glaucoma patients in Bauchi state, Nigeria."

Abdull, M. M., C. Gilbert, J. McCambridge and J. Evans (2014). "Adapted motivational interviewing to improve the uptake of treatment for glaucoma in Nigeria: study protocol for a randomized controlled trial." Trials **15**(1): 149.

Name: Jim McCambridge

Sign:

A handwritten signature in cursive script, appearing to read "Jim McCambridge", is centered within a light purple rectangular box.

Date: 14/12/16

To Abdull

I agree that our work indicated below can be included in its/their published format in your thesis titled "Adapted motivational interviewing to improve uptake of treatment in glaucoma patients in Bauchi state, Nigeria."

1. Bastawrous, A., Burgess, P. I., Mahdi, A. M., Kyari, F., Burton, M. J. and Kuper, H. (2014), Posterior segment eye disease in sub-Saharan Africa: review of recent population-based studies. Trop Med Int Health, 19: 600–609. doi:10.1111/tmi.12276

Name: Hanna Kuper

Sign: 

Date: 14/12/16.

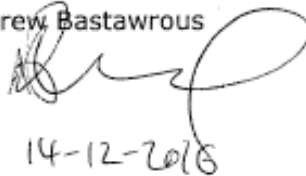
To Abdull

I agree that our work indicated below can be included in its/their published format in your thesis titled "Adapted motivational interviewing to improve uptake of treatment in glaucoma patients in Bauchi state, Nigeria."

1. Kyari F, Abdull MM, Bastawrous A, Gilbert CE, Faal H. Epidemiology of glaucoma in sub-saharan Africa: prevalence, incidence and risk factors. Middle East Afr J Ophthalmol. 2013 Apr-Jun;20(2):111-25. doi: 10.4103/0974-9233.110605. Review. PubMed PMID: 23741130; PubMed Central PMCID: PMC3669488.
2. Bastawrous, A., Burgess, P. I., Mahdi, A. M., Kyari, F., Burton, M. J. and Kuper, H. (2014), Posterior segment eye disease in sub-Saharan Africa: review of recent population-based studies. Trop Med Int Health, 19: 600-609. doi:10.1111/tmi.12276

Name: Andrew Bastawrous

Sign:



Date:

14-12-2016

To Abdull

I agree that our work indicated below can be included in its/their published format in your thesis titled "Adapted motivational interviewing to improve uptake of treatment in glaucoma patients in Bauchi state, Nigeria."

1. Abdull, M. M., C. C. Gilbert and J. Evans (2015). "Primary open angle glaucoma in northern Nigeria: stage at presentation and acceptance of treatment." BMC Ophthalmol 15(1): 111.
2. Abdull, M. M., C. Gilbert, J. McCambridge and J. Evans (2014). "Adapted motivational interviewing to improve the uptake of treatment for glaucoma in Nigeria: study protocol for a randomized controlled trial." Trials 15(1): 149.

Name: Jennifer Evans

Sign:



Date: 15/12/16

To Abdull

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Name: Matthew Burton

Sign: 

Date: 14/12/16

To Abdull

I agree that our work indicated below can be included in its/their published format in your thesis titled "Adapted motivational interviewing to improve uptake of treatment in glaucoma patients in Bauchi state, Nigeria."

1. Abdull, M. M., C. Chandler and C. Gilbert (2016). "Glaucoma, "the silent thief of sight": patients' perspectives and health seeking behaviour in Bauchi, northern Nigeria." BMC Ophthalmology **16**(1): 1-9

Name: Clare Chandler

Sign: 

Date: 14.12.16

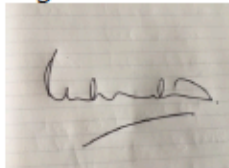
To Abdull

I agree that our work indicated below can be included in its/their published format in your thesis titled "Adapted motivational interviewing to improve uptake of treatment in glaucoma patients in Bauchi state, Nigeria."

1. Kyari F, Abdull MM, Wormald R, Evans JE, Nolan W, Murthy GVS, Gilbert CE, on behalf of the Nigeria National Blindness and Visual Impairment Study Group. Risk factors for open-angle glaucoma in Nigeria. Results from the Nigeria National Blindness and Visual Impairment Survey. BMC Ophthalmology. 2016; 16:78. DOI 10.1186/s12886-016-0264-7.
2. Kyari F, Abdull MM, Sallo FB, Spry PG, Wormald R, Peto T, Faal HB, Gilbert CE; Nigeria National Blindness and Visual Impairment Study Group. Nigeria normative data for defining glaucoma in prevalence surveys. Ophthalmic Epidemiol. 2015 Apr;22(2):98-108. doi: 10.3109/09286586.2015.1012268. PubMed PMID: 25777309.

Name: Richard Wormald

Sign:

A handwritten signature in dark ink on a light-colored, slightly textured background. The signature is cursive and appears to read 'Richard Wormald'.

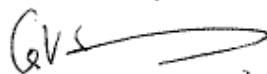
Date: 3/1/17

To Abdull

I agree that our work indicated below can be included in its/their published format in your thesis titled "Adapted motivational interviewing to improve uptake of treatment in glaucoma patients in Bauchi state, Nigeria."

1. Kyari F, Abdull MM, Wormald R, Evans JE, Nolan W, Murthy GVS, Gilbert CE, on behalf of the Nigeria National Blindness and Visual Impairment Study Group. Risk factors for open-angle glaucoma in Nigeria. Results from the Nigeria National Blindness and Visual Impairment Survey. BMC Ophthalmology. 2016; 16:78. DOI 10.1186/s12886-016-0264-7.

Name: GVS Murthy

Sign: 

Date: 03.01.2017

To Abdull


I agree that our work indicated below can be included in its/their published format in your thesis titled "Adapted motivational interviewing to improve uptake of treatment in glaucoma patients in Bauchi state, Nigeria."

1. Bastawrous, A., Burgess, P. I., Mahdi, A. M., Kyari, F., Burton, M. J. and Kuper, H. (2014), Posterior segment eye disease in sub-Saharan Africa: review of recent population-based studies. *Trop Med Int Health*, 19: 600–609. doi:10.1111/tmi.12276

Name: Philip I Burgess

Sign: 
Dr. Philip Burgess

Date: 03/01/17

From: ish098062@lshtm.ac.uk mohammed.abdull@lshtm.ac.uk 
Subject: Request to use our article in my PHD
Date: 14 December 2016 at 13:18
To: pp.winifred.nolan@moorfields.nhs.uk

MA

Dear W Nolan,

I wish to include our work in my thesis titled "Adapted motivational interviewing to improve uptake of treatment in glaucoma patients in Bauchi, Nigeria" and request your permission as a co-author to include the work in their published format.

Please could you kindly complete the attached form and email back to me asap.

Thank you

Best wishes

Abdull Mohammed



Publication
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